JOSEPH KOLEE

LINKING GREEN GROWTH, FINANCIAL DEVELOPMENT, AND AIR POLLUTION IN SUB-SAHARAN AFRICA.

MSc. THESIS

FEBRUARY, 2023

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Approval

We certify that we have read the thesis submitted by **JOSEPH KOLEE** titled " **LINKING GREEN GROWTH, FINANCIAL DEVELOPMENT, AND AIR POLLUTION IN SUB-SAHARAN AFRICA.**" and that in our combined opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Educational Sciences.

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Declaration

I confirm that the data, materials, methods, and conclusions contained in this thesis have been obtained and reported in compliance with the criteria of the Institute of Graduate Studies at Near East University. I also certify that this thesis has been read and approved by the committee. In addition, I guarantee that every piece of non-original content that has been included in this work has been appropriately attributed and cited in accordance with these principles of conduct and practices.

JOSEPH KOLEE

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Abstracts

Linking Green Growth, Financial Development, and Air Pollution in Sub-Saharan Africa.

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In the body of extant literature, there is controversy regarding the unbalance relationship between economic growth, financial development, energy consumption, and environmental sustainability. When it comes to a country's long-term prosperity, energy is seen as crucial. However, as it is in the case with the majority of emerging nations, Sub-Saharan Africa needs to assault an equilibrium amid fiscal growth and the conservation of the environment. It is estimated that 1.1 million people in Sub-Saharan Africa are exposed to environmental air pollution. Tackling issues that are caused by climate related challenges have emerged as a crucial priority for environmental policy, particularly in regard to the achievement of the United Nations 2030 Sustainable Development Goals (SDGs) associated to SDG-7, 12 and 13. In light of the Sustainable Development Goals established by the United Nations, which aim to promote "clean and responsible energy usage," "mitigation of climate change," and "sustainable economic growth" (UN-SDGs-7, 12–13), the thesis assess the economic and health sustainability corridor; in particular, linking green growth, renewable energy consumption, and financial development on air pollution in Sub-Saharan Africa. This thesis' empirical analysis is based on Panel data spanning between 2010 and 2022. The utilized novel econometric methods of the newly developed Panel modelling of Mean Group (GM) and Pooled Mean Group (PMG) estimate approaches, as well as Dynamic Fixed Effect (DFE) and the Dumitrescu-Hurlin causality test, for more precision. Overall, the findings verify that (i) the estimated variables have both short-long run equilibrium co-integration relationship; and (ii) green growth, financial development and renewable energy consumption have affirmative short-long run influence in reducing air pollution in Sub-Saharan Africa. The outcomes suggest that green growth, financial development

and renewable energy consumption are the most effective determinants and have the greatest effect on air pollution. Other problems must be addressed, such as underdeveloped patent policy, insufficient resource management, pervasive corruption and bureaucratic complexities in order to hardness the achievement of the targets concerning objectives of SDG-7, 12 and13, respectively. The results of this research may be significant to those who make choices in light of evolving circumstances in sub-Saharan Africa, such as policymakers, managers of health systems, and representatives of humanitarian organizations. In addition, the thesis makes a number of significant recommendations for public policy and presents fresh points of view to countries in sub-Saharan Africa at a time when these countries are developing national initiatives to advance ecological sustainability and achieve their goal of net-zero emissions. This thesis is one of an extremely small number of assessments of the economic and health sustainability corridor that have been carried out up to this point. In particular, the thesis draws a relationship between green growths, use of renewable energy sources, monetary development, and air pollution in countries located in sub-Saharan Africa.

Keywords**: G**reen Growth, Renewable Energy, Financial Development, Panel model, Sub-Saharan Africa

Özet

Sahra altı Afrika'da yeşil büyüme, finansal gelişme ve hava kirliliği arasında bağlantı kurma.

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Mevcut literatürde, ekonomik büyüme, finansal gelişme, enerji tüketimi ve çevresel sürdürülebilirlik arasındaki dengesizlik ilişkisine ilişkin tartışmalar bulunmaktadır. Bir ülkenin uzun vadeli refahı söz konusu olduğunda, enerji çok önemli görülüyor. Bununla birlikte, gelişmekte olan ülkelerin çoğunda olduğu gibi, Sahra Altı Afrika'nın da mali büyüme ve çevrenin korunması arasında bir dengeye saldırması gerekiyor. Sahra Altı Afrika'da 1,1 milyon insanın çevresel hava kirliliğine maruz kaldığı tahmin ediliyor. İklimle ilgili zorlukların neden olduğu sorunların ele alınması, özellikle SDG-7, 12 ve 13 ile bağlantılı Birleşmiş Milletler 2030 Sürdürülebilir Kalkınma Hedeflerine (SDG'ler) ulaşılmasına ilişkin olarak çevre politikası için çok önemli bir öncelik olarak ortaya çıkmıştır. "Temiz ve sorumlu enerji kullanımı", "iklim değişikliğinin hafifletilmesi" ve "sürdürülebilir ekonomik büyüme"yi (BM-SDGs-7, 12–13) teşvik etmeyi amaçlayan Birleşmiş Milletler tarafından belirlenen Sürdürülebilir Kalkınma Hedefleri ekonomik ve sağlık sürdürülebilirlik koridoru; özellikle yeşil büyümeyi, yenilenebilir enerji tüketimini ve finansal gelişmeyi Sahra Altı Afrika'daki hava kirliliği ile ilişkilendirmek. Bu tezin ampirik analizi, 2010 ve 2022 yıllarını kapsayan Panel verilerine dayanmaktadır. Ortalama Grup (GM) ve Havuzlanmış Ortalama Grup (PMG) tahmin

yaklaşımlarının yeni geliştirilen İkinci Nesil Panel modellemesinin yeni ekonometrik yöntemleri ve Dereceler kullanılmıştır. Dinamik Sabit Etki (DFE) ve Dumitrescu-Hurlin nedensellik testi. Genel olarak, bulgular (i) tahmin edilen değişkenlerin her ikisinin de kısa-uzun dönem denge eşbütünleşme ilişkisine sahip olduğunu; ve (ii) yeşil büyüme, finansal gelişme ve yenilenebilir enerji tüketimi, Sahra Altı Afrika'daki hava kirliliğini azaltmada kısa ve uzun vadede olumlu etkiye sahiptir. Sonuçlar, yeşil büyüme, finansal gelişme ve yenilenebilir enerji tüketiminin en etkili belirleyiciler olduğunu ve hava kirliliği üzerinde en büyük etkiye sahip olduğunu göstermektedir. Sırasıyla SDG-7, 12 ve 13 hedeflerine ulaşılmasını zorlaştırmak için az gelişmiş patent politikası, yetersiz kaynak yönetimi, yaygın yolsuzluk ve bürokratik karmaşıklıklar gibi diğer sorunların ele alınması gerekmektedir. Bu araştırmanın sonuçları, politika yapıcılar, sağlık sistemleri yöneticileri ve insani yardım kuruluşlarının temsilcileri gibi Sahra-altı Afrika'da gelişen koşullar ışığında seçim yapan kişiler için önemli olabilir. Buna ek olarak, tez, kamu politikası için bir dizi önemli tavsiyede bulunmakta ve bu ülkelerin ekolojik sürdürülebilirliği ilerletmek ve net sıfır emisyon hedefine ulaşmak için ulusal girişimler geliştirdiği bir zamanda Sahra-altı Afrika'daki ülkelere yeni bakış açıları sunmaktadır. . Bu tez, ekonomik ve sağlık sürdürülebilirliği koridorunun bu noktaya kadar yapılmış son derece az sayıdaki değerlendirmesinden biridir. Tez, özellikle Sahra altı Afrika'da bulunan ülkelerde yeşil büyüme, yenilenebilir enerji kaynaklarının kullanımı, parasal gelişme ve hava kirliliği arasında bir ilişki çizmektedir.

Anahtar Kelimeler: Yeşil Büyüme, Yenilenebilir Enerji, Finansal Gelişme, İkinci Nesil, Sahra Altı Afrika

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Abbreviations

SDG:	Sustainable Development Goal
GHG:	Greenhouse Gases
IPCC:	Intergovernmental Panel on Climate Change
EPA:	Environmental Protection Agency
UN:	United Nations
COP27:	27^{TH} Conference of the Parties
EKC:	Environmental Kuznets Curves
CIPS:	Cross Sectional I'm Pesaran and Shin
CADF:	Cross Sectional Augmented Dickey-Fuller
NAAQS:	National Ambient Air Quality Standards
CAFÉ:	Corporation Average Fuel Economy
COPD:	Chronic Obstructive Pulmonary Disease
COVID-19:	Coronavirus Disease
NGOs:	Non-governmental Organizations
SSA:	Sub-Saharan Africa
GDP:	Gross Domestic Product
UNDP:	United Nation Development Program
WHO:	World Health Organization
SMEs:	Small and Medium-sized Enterprises
SMMEs:	Small and Medium-sized Manufacturing Enterprises
PMG-ARDL:	Pooled Mean Group-Autoregressive Distributed Lag

OLS: Ordinal Logistic Regression

APEC: Asia-Pacific Economy Cooperation

IEA: International Energy Agency

MENA: Middle East and North Africa

OECD: Organization for Economic Co-operation and Development

BRICS: Brazil, Russia, India, China and South Africa

AMG: Augmented Mean Group

FMOLS: Fully Modified Ordinary Least Square

EU: European Union

ARDL: Autoregressive Distributed Lag

VECM: Vector Error Correction Model

NRE: Non-Residential External

FDI: Foreign Direct Investment

EP: Environmental Performance

SESAME: Sustainable Energy System Analysis Modeling Environmental

FCM: Fuzzy Cognitive Map

CGE: Consultative Group of Experts

KMO: Kaiser-Meyer-Olkin

MLE: Maximum likelihood Estimate

ECT: Error Correction Term

EPRA: Electric Power Regulatory Authority's

AIC: Akaike Information Criterion

SIC: Schwarz-Bayersian Information Criterion

CHAPTER I

Introduction

Background of the Study

The seventh Sustainable Development Goal (SDG) aims to ensure that people all around the globe have access to energy that is dependable, cheap, and environmentally friendly (Wang et al., 2020). The experts are in agreement that the accessibility of a variety of sources of energy, including those that are not renewable, has a major bearing on the economy and society as conditions of a society (Kirikkaleli & Sowah, 2022). The use of non-renewable resources, such as coal, oil, and natural gas has driven much of the world's urbanization and industrialization during the last three decades. This pattern was seen for the first time in the 1970s and has not been broken since then (Sowah & Kirikkaleli, 2022). An ever-increasing corpus of research suggests that links the growing need for energy to sustain human advancement and economic expansion with the degradation of the environment in a variety of different nations. This is due to the rising amounts of various pollutants in the environment (Doanalp, Ozsolak, & Aslan, 2021). When fossil fuels are burnt, two types of gases are produced: greenhouse gases (GHG) and carbon dioxide (CO2). Both of these gases contribute considerably to the harm that is done to the environment (Liu et al., 2022). When used in its traditional sense, the term "climate change" refers to large alterations in the global distribution of precipitation and temperature that take place over extended lengths of time (Kirikkaleli & Sowah, 2021). The results of the most current assessment from Indicators of Climate Change: A Report from the Intergovernmental Panel on Climate Change reinforce the mounting concerns of political leaders, academics, and other stakeholders in all parts of the globe that climate change constitutes a direct danger to human existence and the future of sustainable development. The Intergovernmental Panel on Climate Change has concluded in its most recent report that climate change is a direct cause of danger to human existence and the future of sustainable development (IPCC). The health of the natural world and the human civilization that depends on it are both under grave and increasing risk by way of an outcome of climate change. The world's average temperature will increase by just 1.5 degrees Celsius (2.7 degrees

Fahrenheit) over the course of the next two decades, but this will virtually certainly result in a high number of climate-related disasters of catastrophic proportions (IPCC, 2022). Because of the unprecedented levels of harmful carbon emissions between 2010 and 2019, scientists have been cautioned that they have "now or never" to bring global warming down to 1.5 degrees Celsius. This warning is in response to the fact that between 2010 and 2019 there will be an increase in emissions of more than 40 gig tons of carbon. This is because of the record levels of emissions that occurred between 2010 and 2019. (UN, 2022). Since the middle of the 20th century, human activities have been the dominant driver of visible climate change, with global warming due to greenhouse gases being the primary reason. According to the findings of a recent study conducted by the Environmental Protection Agency of the United States in accordance with the Paris Agreement of 2015, greenhouse gas emissions need to be cut to either 2 degrees Celsius or 1.5 degrees Celsius by the year 2030 in order to avert an ecological catastrophe.

According to the findings of a number of research, it is imperative that people cut their yearly emissions of carbon dioxide to a level that is between 0.8 and 2.5 tons of CO2 equivalent (EPA, 2022). A few of countries in sub-Saharan Africa could be responsible for more than half of the world's greenhouse gas emissions. These countries are home to a combined population of more than 1.1 billion people. Cooperation is required across geographically distinct locations in command to mitigate the effects of weather variation and speed up the shift to renewable energy sources. The Western industrialized countries, the Nigerian megacities, and the Central African highlands are all examples of such places (African Development Bank, 2022). Fossil fuel combustion is the major contributor to Africa's greenhouse gas emissions, accounting for 73% of those emissions. It is very necessary for the nations located in sub-Saharan Africa to undertake the transition to cleaner forms of energy if emissions are to be reduced to an acceptable level. This shift is essential because, since 2000, the energy consumption of the nations that make up Sub-Saharan Africa has increased by a factor of 50. It is anticipated that the region's need for energy would increase by around the same amount throughout the course of the following decade (World Bank, 2021).The combustion of coal, a fossil fuel that adds to most significant contributor to the release of heat-trapping gases and hence the

global warming issue. Coal continue to be the main supply of power for the majority of countries in Africa—80 percent, to be exact—but just 30 percent of G20 nations. It is anticipated that global emissions of greenhouse gases would decline by half by the year 2030; however, this will not occur unless the production of coal is eliminated gradually over time.

There is an extremely low probability that average global temperatures will drop by less than 1.5 degrees Celsius. Africa is now experiencing some of the worst heat waves, droughts, and floods in recorded history. This is despite the fact that the average temperature throughout the globe has only climbed by 1 degree Celsius (UN, 2022). (UN, 2022). As a result of these worries, many nations, both advanced and emerging, have implemented regulations to restrict the amount of global warming that may be attributed to them. Some of the most well-known examples are the USA, the EU, and China. As a result, initiatives are being launched on every continent with the aim of expanding the use of renewable energy sources as part of the global response to climate change. As a result of the Paris Agreement of 2015 and the Convention on Climate Change, the worldwide community was able to convene in Sharm el-Sheikh for the 27th Conference of the Parties (COP 27) to address climate change and take action toward reaching these objectives. The event was held during climate change treaty established by the United Nations. The purpose of the meeting, as indicated, was to go on with developing specific strategies to attain these goals. The countries of sub-Saharan Africa have made considerable strides in electrifying their populations, with the result that electricity is now reaching even the most remote parts of the continent (World Bank, 2022). The biggest bank in the world believes that this will be the case in 2022. However, it is necessary to clearly define the development benefits that come from a larger availability of renewable energy sources that are also cost-effective. These advantages arise from having a better availability of renewable energy sources. By the year 2050, it is possible that renewable energy may satisfy as much as two-thirds of the world's need for energy. Because of this, laying the groundwork for a future low-carbon economic revolution is dependent on the widespread use and advancement of technology that makes use of alternative energy sources. Reason being, broad adoption of renewable energy is essential for a low-carbon economic revolution. Dangers that global warming and climate change a growing danger to the

worlds continues to rise, devotion has been focused scheduled the dynamic relationship that exists between increasing economies, increased energy use, and increased pollution. Energy and its connection to and expansion has been the subject of a significant amount of research. Due to differences in energy consumption patterns and methods of modeling, the study shows that different countries have produced contradictory conclusions (Kirikkaleli & Sowah, 2020). Researchers who study the link between growing economies and rising pollution levels often see a trend known as the Environmental Kuznets Curve (EKC). The marks of these studies support the theory that pollution levels rise in tandem with expanding economies up to a certain threshold, after which point they begin to fall (Cheikh, Zaied, & Chevallier, 2021; Boukhelkhal, 2022). (Cheikh, Zaied, & Chevallier, 2021; Boukhelkhal, 2022). On the other hand, as a number of other pieces of study have shown, the environmental Kuznets curve could not be applicable to all types of toxins or to all countries. Recent research (You, Zhang, & Lee, 2022; Sowah, Kirikkaleli, & Genc 2021) has concentrated about the bond between expanding monetary activity, increasing energy use, and increasing contamination levels. The majority of the early study neglected the disparate influences that focus on overall energy use, global warming, and economic expansion. as opposed to the impact that C.E.C. has on climate change and growth individually. This deconstruction unbolts up new paths for research into the comparative capabilities of the two different types of energy sources with regard to climate change and the expansion process. It is our hope that this research will help close a knowledge gap in knowledge on a number of developing countries in sub-Saharan Africa, including but not limited to Nigeria, South Africa, Liberia, Ghana, and others. These countries were chosen because of their reputation for being very sensitive to climate change impacts. In addition, there have only been a few of studies conducted on particular African countries within this field thus far.

The focus of this study is on expanding our understanding of the connection between developing economies in Sub-Saharan Africa's economic expansion, financial development, using alternative energy methods, and green growth between the years of 2010 and 2021. The newly published study contributes in a variety of ways to the body of previous scholarly work that already exists. To begin, this empirical research takes into account weather conditions by looking at things like the average

temperature and the amount of precipitation. Second, in contrast to earlier evaluations, our method takes into account in a proactive manner green growth and renewable energy sources, both of which are essential to the region's ability to achieve sustainable development. Third, this research makes use of a cross-sectional dependency a check to see whether a variable model of panel data exhibits cross-sectional dependence. The first-generation panel unit root test cannot be used because of problems with cross-sectional dependent data. As a result, this study uses the second-generation unit root test that was presented by Pesaran (2007) in order to take cross-sectional dependence into consideration. Taking into consideration both of these considerations, it has been shown via experimentation that the CIPS and CADF unit-root tests are effective when applied to panel datasets. In order to investigate the long-term co-integration of variables, Westerlund makes use of two different co-integration tests (2007). (2007). The Mean Group (GM), Pooled Mean Group (PMG), and Degrees of Freedom for Error (DFE) estimations, which are used in this analysis in order to take parameter discrepancies and biased features of our estimated variables into consideration, can also be used to explore the long-term coefficient variable elasticities. These estimations are used so that we may correct for parameter discrepancies and the biased nature of our estimated variables. These models and procedures, in contrast to more conventional research approaches, have the potential to provide more reliable results while simultaneously overcoming the difficulties posed by cross-sectional interdependence and country-specific volatility. The most important benefit that can be gained from using these estimators is that they may potentially assist in the accomplishment of further appropriate policy-oriented aims and give results that are unique to each nation. Dumitrescu and Hurlin's panel causality test (2012), which was used in this study, may be used to address cross-sectional dependencies as well as the directions in which causality can be shown to be operating. The discoveries of this study have allegations for the delivery of a full policy platform that will allow businesses, governments, and policy experts to scale up their impact in the direction of achieving the Sustainable Development Goals (SDGs), namely SDGs 7 and 13, respectively.

Problem Statement

As of right now, metropolitan regions are home to more than half of the world's population. However, this percentage is projected to climb to one-third by the year 2030 as an increasing number of people move to the world's 500 largest cities. There are now 31 urban regions that qualify as "megacities," which are defined as having populations of 10 million people or more. The expansion of metropolitan areas and the populations that live within them around the world brings with it a slew of new environmental issues that are systemic in nature. According to the World Health Organization's definition, someone who is healthy possesses a state of complete well-being throughout all aspects of their being, including their physical health, mental state, and social life. When trying to improve public health, there are many different aspects of health that need to be taken into consideration. Some of these include social factors, environmental quality, energy, transportation, and access; housing and living conditions; equity; sustainability; safety; governance; economic opportunities; diet; exercise; stress; and other lifestyle factors; infectious and non-infectious diseases; injuries; and mortality. The environmental and economic obstacles that need to be conquered are difficult because of the interconnected nature of many of these concerns. To overcome these obstacles and pave the way for more secure futures that have a beneficial impact on the health of communities as a whole, constant innovation is essential.

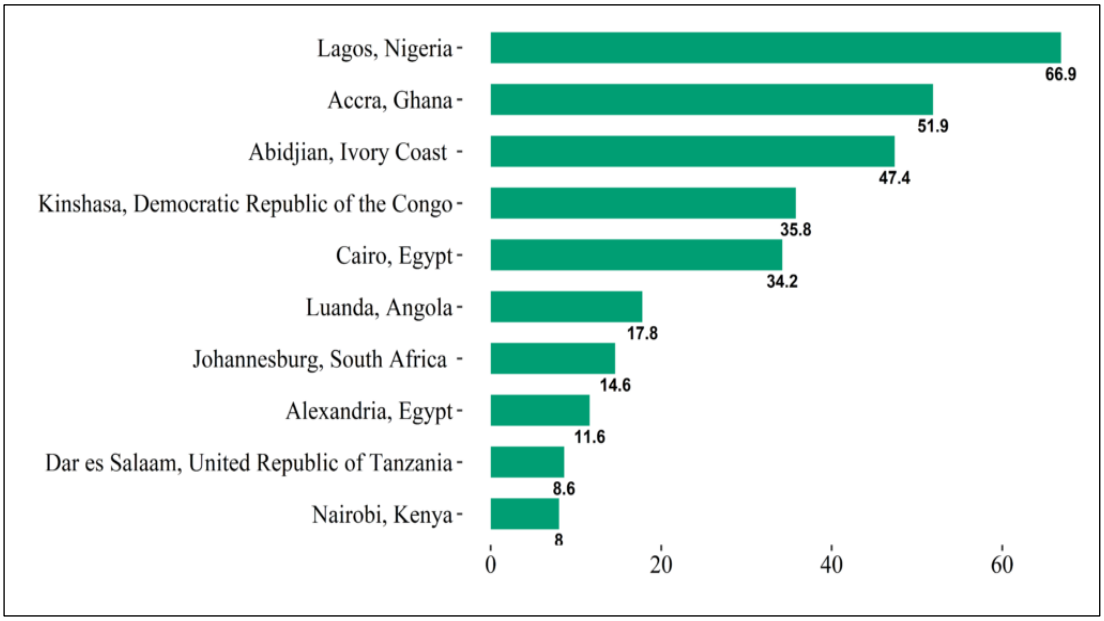
There is a strong possibility that human health and environmental health are inextricably linked. Castanho and Martn Gallardo conducted a study on environmental management for the protection of Mediterranean ecosystems. In their findings, they discovered that urban air pollution has a significant impact on people's health in cities all over the world. Castanho and Martn Gallardo are responsible for carrying out the research that resulted in these conclusions (2021). In 2015, environmental air pollution was the sixth biggest cause of death, and it was responsible for 4.2 million fatalities around the world. That is to say, unfavorable environmental circumstances may be responsible for as much as 23 percent of the total sickness burden worldwide. Citation: (Castanho & Martn Gallardo, 2021). (Castanho & Martn Gallardo, 2021). "(Castanho & Martn Gallardo, 2021). (Castanho & Martn Gallardo, 2021). Because a person's capacity to breathe clean air is critical

to their overall health, it is crucial for them to have an understanding of the factors that contribute to air pollution and the steps they may take to combat it. To put it another way, the atmosphere is comprised of a vast range of different gases, liquid vapors, volatiles, and particles. Both stationary sources, such as power plants, and mobile sources, such as cars, contribute to the quality of the air that is contaminated; however, natural events also have a part in this (such as vehicles, trucks, and buses). Pollutants in the air, especially those that are dangerous, have the potential to travel great distances and undergo changes in the atmosphere, which serves as a carrier for such occurrences. A number of states have passed laws that are designed to protect their economies, and an equal number of states have formed institutions to monitor issues such as air pollution. These laws and organizations are both designed to protect the states' economies. In particular, the National Ambient Air Quality Standards (NAAQS) for air pollution are mandated by the Clean Air Act in the United States. It is the responsibility of the Environmental Protection Agency (EPA), along with associated state and regional agencies, to implement the legislation regarding these standards. The National Ambient Air Quality Standards (NAAQS) have defined threshold levels for the following six types of air pollutants: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO2), ozone (O3), particulates (PM2.5, PM10), and sulfur dioxide (SO2) (SO2). The following is a list of the many different forms of air pollutants: (SO2). There is a possibility that environmental organizations will be able to restrict or otherwise influence the amount of pollution that enterprises discharge into the atmosphere (e.g., US CAFE standards for vehicle fuel efficiency and the permitting process for pollutant emissions from industrial facilities).

The average age of a person in Africa is just 197 years old, and the continent's overall population is expected to expand from 13 billion to 43 billion by the end of this century. It is estimated that by the year 2100, the continent would be home to thirteen megacities, which is evidence of the tremendous urbanization that is taking place there. The economy of African countries, as well as their rate of industrialization and progress in building infrastructure, is all on the increase (panel 1). The environmental dangers that the continent is now confronting are transitioning from those that were caused by pollution in the past to those that are caused by pollution in the present. Despite the fact that home sources of air pollution continue to dominate, those sources are on the decrease, whilst the sources of air pollution that

come from the environment are on the increase. Concurrently, there has been a substantial movement in the epidemiology of African nations away from communicable diseases and toward non-communicable diseases. In spite of the growing body of information suggesting that air pollution is harmful to human health, the environment, and the economy, no definitive conclusions can be drawn. Figure 1 depicts countries in sub-Saharan Africa that are among the most significant contributors to the warming of the planet.

Figure 1: Sub-Saharan Africa countries with higher contribution of air pollution



It is not impossible for the living circumstances of a population to affect health in important ways and happiness of the people who inhabit that population. Castanho and Martn Gallardo (2021) conducted a research for Environmental Management on the Conservation of Mediterranean Environments that found that there is a negative affect that air pollution has on the health of the general people in cities all over the world. Particularly, ambient air pollution is accountable for the loss of 4.2 million lives each year, placing it as the seventh largest cause of death around the globe (Castanho and Martn Gallardo, 2021). This might account for as much as 23 percent of the disease burden that is experienced on a global scale as a direct outcome of environmental quality. Because the quality of the air that people breathe is so

important to their overall health, it is of the utmost importance that they be educated about the sources of the pollution in the air around them as well as the methods that may be used to lessen the effects of that pollution. The air that is all about us is composed of a variety of different components, some of which are gases, while others include liquid vapor, volatiles, and solid particles. Some of these components make up the air that we breathe. Even though some of the air around you is made up of substances that are produced by natural processes, a sizeable portion of it is also the product of man-made pollution that has been released into the atmosphere by sources that are either stationary (like factories) or mobile (like cars and trains). This pollution has been caused by the release of harmful substances into the atmosphere (like cars and trains). It is not out of the question that the activities that take place in the environment might be responsible for the transportation and transformation of toxins that are present in the air. In many countries, environmental authorities are in charge of regulating and monitoring air quality. Additionally, the quality of the air itself is subject to regulations that are designed to protect the economy. In particular, the Clean Air Act the laws of the United States of America the development of National Ambient Air Quality Standards (NAAQS) as a means of addressing issues pertaining to air pollution. Enacting laws that will safeguard the purity of the air that we breathe The Environmental Protection Agency as well as any other state or regional authorities that may be relevant are responsible for enforcing these requirements. The findings of this investigation were presented in a publication called (LaCount, Haeuber, Macy, & Murray, 2021). LaCount, Haeuber, Macy, and Murray will all be members of the team as of the year 2021. The National Ambient Air Quality Standards (NAAQS) have customary standardized limitations for sulfur dioxide (SO2), nitric oxide (NO2), ozone (O3), lead (Pb), nitrogen dioxide (NO2), particulate matter (PM2.5, PM10), and carbon monoxide (SO2). These the polluters that contribute to smog (SO2). Environmental authorities have the ability to influence or restrict pollutant emissions at the source through the implementation of policies and procedures such as the Corporate Average Fuel Economy (CAFE) rules in the United States for automobiles and the licensing procedure for pollutant emissions from industrial facilities. These emissions are subject to the influence and control of many environmental groups (e.g., The Corporate Average Fuel Economy (CAFE) regulations in the United States involve the regulation of pollutant emissions from factories.).

It is now again the job of government environmental authorities to monitor air quality in order to evaluate whether or not the criteria are being met once the standards have been established. However, traditional air quality monitors may not always provide data that can be relied upon. Given that the Environmental Protection Agency (EPA) of the United States is only responsible for regulating around 4000 locations, it is possible that many municipalities and localities may not have access to trustworthy data on the monitoring of air quality (LaCount, Haeuber, Macy & Murray, 2021). The relationship among air contamination and human fitness, as well as the societal and fiscal repercussions of this issue, have been the subject of a significant amount of research; despite this, there is a dearth of data on the monitoring of air quality (Kirikkaleli & Sowah, 2021). Several different processes, such as increased respiratory sensitivity to allergens, oxidative stress, airway remodeling, inflammatory pathways are all possible ways that air pollution might cause damage to the airways (Kirikkaleli & Sowah, 2021; LaCount, Haeuber, Macy, & Murray, 2021). Inflammation of the airways may be caused by a number of environmental irritants, including ozone, nitrogen dioxide, and PM2.5. It has been shown that prolonged exposure to high levels of a diversity of pollutants has dangerous effects for human health, including increased risk of mortality from all causes as well as respiratory issues (such as bronchitis and asthma). According to the findings of a study that involved more than 1800 female participants, the risk of a cardiovascular event improved by 24% for in accordance with an increase in PM2.5 of 10 g/m3, the mortality rate from cardiovascular disease rose by 76%. Both of these increases occurred for every 10 g/m3 rise in PM2.5. The link association between prenatal exposure to air pollution and adverse effects, including obesity, cognitive impairment, and metabolic disease aging, and Alzheimer's disease is just one example of the new linkages that are being discovered between elements that were previously unknown. Other examples include the link between certain air pollution exposures and metabolic illness, aging, and aging-related cognitive decline. However, there is still a lot we don't know about how exactly air pollution triggers and worsens a wide range of diseases.

Recent studies have also shown that certain geographic locations are more severely impacted by air pollution than others. The findings of the study served as the foundation for this conclusion. Some regions of the nation may have greater levels of air pollution than others due to a variety of factors, such as differences in

socioeconomic status and past redlining. This disparity in air pollution levels contributes to environmental justice concerns. Several of these theories are listed below for your perusal: In addition, research has shown that certain individuals are more susceptible to the dangers to their health that are presented by air pollution. Those who already have medical conditions, such as Children with asthma, people with COPD, and adults with cardiovascular disease are all at a higher risk for further health issues if they are exposed to high levels of air pollution. Study conducted at Harvard University in the situation of the present COVID-19 outbreak discovered a momentous association between long-term financial inflow from polluting businesses and air pollution. The research was carried out in the United States. According to the findings, there was an 8% rise in both air pollution and death rates for every 1 g/m3 increase in the concentration of hazardous compounds.

Community organizations that are not affiliated with any government in sub-Saharan Africa play an essential part in the fight against air pollution and have made significant contributions to the decrease of pollution levels. For instance, the decisions that land use planning organizations make about zoning and siting may have an effect on how near sources of industrial air pollution are to a neighborhood. Because of the plans and regulations that have been put into place, the amount of pollution that is present in the environment may be influenced by the department of transportation. The accessibility of different modes of transportation, as well as public health, will be impacted as a result of these policies and regulations. Concern about the negative impact that air pollution has on people's health should come as no surprise to those who are in charge of people's health and who are responsible for the population as a whole. The efforts of environmental NGOs (non-governmental organizations) to promote environmental justice and quality are also very important. Concerned citizens, whose voices are magnified by these organizations, are often those who have good cause to worry for their health as a consequence of environmental concerns. Not only the organizations that have been listed above, but also a great number of other entities, have a financial stake in seeing to it that high quality air standards are maintained.

Previous studies have shown that reducing levels of air pollution in wilderness regions is a difficult endeavor to undertake. For an economy to make the transition to one that is resilient and zero-sum, new measures must be taken by companies to enhance the management of natural resources, adopt creative solutions, and make a

contribution to sustainable development. To encourage national governments and enterprises to include sustainable development into their plans and policies and to take action to build a more secure future for their people and themselves, the United Nations (UN) has established a variety of frameworks. Examples include the 1992 Earth Summit in Rio, which resulted in the establishment of COP-27, now taking place in Sharm el-Sheikh, Egypt; the UNFCCC; the UN Conference of the Parties in Berlin in 1995; the Paris Agreement of 2015; and the UNFCCC itself. During the United Nations Climate Change Conference in 2015, which took place in Sharm el-Sheikh, Egypt, delegates from all over the world gathered together to discuss and debate various strategies for achieving the ambitious global climate targets established by the Convention and the Paris Agreement on Biological Diversity (COP 27). Green growth and renewable energy resources have the potential to play a significant role in the development of unique and effective solutions to environmental air pollution challenges; nevertheless, there are large knowledge gaps and obstacles to achieving this goal. This is because green growth and renewable energy resources have the potential to make a significant contribution to the discovery of cutting-edge approaches to air pollution control. This is the case in spite of the many opportunities that exist to significantly contribute to the cause. The problem is still the same as it was described before, despite the fact that a solution could need input from a range of different sources. The dissemination of new knowledge on the connections between environmentally responsible development, monetary advancement, and the adoption of sustainable power plants in conjunction with commercial development in the nations of Sub-Saharan Africa is the purpose of this study. But in addition to that, they want to address other urgent problems facing the environment.

Purpose of the study

Cutting-edge research is relied on by contemporary economists, policymakers, and managers of air quality to help set legislation and guide management decisions, with the ultimate goal of reducing and regulating air pollution in the most cost-effective way possible. In an attempt to reduce the detrimental impact that air pollution has on both human health and the natural environment, specialists are

directing their attention toward the research of climate change and the development of energy-based technologies. Without new business activities that promote responsible resource stewardship, implement creative solutions, contribute to sustainable development, and embrace responsible behaviours, the economy will not be able to make the transition to a state that is resilient and zero-sum. It is imperative that both greenhouse gases and the compounds that serve as precursors to them be brought under control and that emissions be significantly reduced. To accomplish this goal, it will be necessary to address environmental air pollution and point sources in the region, as well as to sustain the execution of policies and procedures that improve the overall air quality in the area. This study's objective is to investigate the factors that contribute to air pollution in Sub-Saharan Africa between the years 2010 and 2021, specifically focusing on the effects of "green growth," "financial development," "use of renewable energy sources," and "economic expansion." The study provides state and municipal environmental protection agencies in Sub-Saharan Africa with the factual data they need in order to make educated judgments on the most effective means by which to decrease and regulate air pollution. Because this region is home to a number of cities that rank among the most polluted in the world, this is an extremely serious matter. It is necessary to identify the sources of environmental concerns and create a comprehensive policy framework in order to find solutions to them in order to maximize the influence that businesses, politicians, and policy experts have on the achievement of Sustainable Development Goals (SDGs), particularly SDGs 7 and 13. This is because in order to maximize this influence, it is necessary to identify the sources of environmental concerns.

Limitation of the study

The policy agenda of the study is considering the impact of green growth, financial expansion, renewable energy, and economic growth on changes in environmental air pollution, suffers from two significant flaws. Both of these flaws are related to the study's methodology. Because of the datasets that were used for this research, there is a possibility that the findings of this study will only be applicable to a subset of the countries that are located in sub-Saharan Africa. Our model estimations could still be impacted by biases and confounding factors despite

the fact that the outcomes of this investigation were obtained utilizing more reliable models and techniques than those that were utilized in the earlier research. Because it is both generalizable and flexible, the policy context that is provided in the research can be utilized as a model by other developing nations. Because of the framework's adaptability, policymakers in Sub-Saharan African countries are able to modify it to suit local circumstances without watering down the fundamental concepts that it was founded on. This very point is where the significance of the study can be found. Researchers are encouraged to continue this line of inquiry look at the possibility of using an asymmetric NARDL model inside a unifying framework and making use of quantile regression to identify environmental asymmetry across countries. Calculating the impact of EKC on the various variables using GDP per capita squared could produce conclusions that are potentially more informative than those now obtained.

Research Objective

The primary objective of this research is to untangle the effects that green growth, financial development, consumption of renewable energy, and economic growth have had on environmental air pollution in Sub-Saharan African (SSA) nations from the years 2010 to 2022. The following is a list of some of the more specific objectives of the research:

i. The objective of this study is to learn in what manner green development distresses environmental sustainability in SSA nations.
ii. Our goal in doing this research is to better understand the link between SSA nations' use of renewable energy sources and the severity of their air pollution problems.
iii. The goal of this study is to disentangle the causes of air pollution in SSA nations from their monetary progress.
iv. Examine the connection between rising economies and increased air pollution in sub-Saharan African nations.

Research Questions

The following study questions have been generated from the above research objectives:

i. How can green development contribute to environmental sustainability in sub-Saharan African nations?
ii. For nations in Sub-Saharan Africa, how does clean energy generation influence pollution levels?
iii. Sub-Saharan African countries, what is the correlation amid rising economic prosperity and rising environmental air pollution?
iv. How does rising GDP affect air quality in developing nations in sub-Saharan Africa?

Research Hypothesis

The dependability of our source of renewable energy is a crucial aspect that will play a role in determining the level of living that we may eventually achieve. When compared to traditional power plants and other energy options, renewable energy sources are favored since they have a smaller negative influence on the surrounding environment and a longer lifespan. This is due to the fact that renewable energy sources, such as wind, biomass, solar activity, geothermal energy, and so on, rely on naturally existing resources in order to supply electricity. In addition, an increased reliance on non-fossil alternatives offers more effective defenses mechanism against the challenges that are currently being faced by the fossil fuel industry. Building on the strong basis created by earlier research, it was a natural next step to speculate on the linkages between the utilization of renewable energy sources, the maturing of financial markets, and the expansion of the economy. Because of the huge amount of research that has been done on the topic. As a result, it should not come as a surprise that earlier studies have led to the conclusion that the usage of renewable energy sources is connected with higher wealth and the advancement of technological innovation (Yazdi & Dariani, 2019; Alam & Murad, 2020; Personal and Archive, 2020; Shahbaz et al., 2018).

Growth hypothesis

There is a widespread belief that Greater energy consumption is expected to boost economic growth. Accelerating economic growth is possible through the implementation of government measures that reduce the demand for and consumption of energy.

Conservation hypothesis

This theory is predicated on the notion that there has been a rise economic activity tips in a corresponding increase in the amount of energy that is used. If this theory is correct, then reducing energy usage by doing things like getting rid of energy subsidies won't slow down the economy even though these types of measures will be taken. However, studies have shown that a nation's rate of economic expansion is directly proportional to the amount of energy it consumes in that nation.

Neutrality hypothesis

According to this theory, the factors that are taken into consideration are not connected in any way that can be characterized as causal. It is not expected that there will be a proportional change in energy consumption brought about by either the implementation of measures that save energy or the expansion of economic activity.

Significance of Research

The findings of this study are significant because they provide policymakers in government, international organizations, academic institutions, environmental protection agencies, technocrats, and development consultants with a improve one's comprehension of the interplay between green growth, financial development, renewable energy use and increased prosperity and how these factors contribute to environmental air pollution. Last but not least, persons in positions of power might utilize the results of the research to make judgments that are more informed. In addition, the conclusions of this study will revealed fresh insight on ways in which

alterations in environmental air pollution levels may be influenced by changes in economic growth, the consumption of energy that doesn't come from fossil fuels, new innovations in a financial markets, and the extension of environmentally friendly practices The paper investigates a variety of topics relating to the encouragement of investment in research and development (R&D), such as the granting of patents on discoveries, the imposition of higher taxes on the use of fossil fuels, and the augmentation of royalties on environmentally beneficial products. This article covers all of those topics, as well as other significant features of environmentally friendly development technologies that have been neglected in earlier studies but are now brought to light. There are a number of instances in which this is the case, including the patenting of financial innovations, the incorporation of R&D costs into financial models, and the use of alternative or renewable sources of energy. The results of this study will provide light on a broad variety of problems, including sustainable development, the availability of renewable energy sources, and the environmental consequences of making use of these energy sources. The primary objective of the study is to direct the course of future research based on the premise that the environmental problems that certain countries are experiencing are a direct result of the inefficient utilization of locally accessible renewable resources that are not only creative but also kind to the environment. By the year 2021, more than 35 percent of the gross domestic product (GDP) of industrialized nations will be derived from renewable energy that was generated on the countries' own territory. The fundamental advantage of doing this research is that they will expand our understanding of environmentally responsible development in addition to other topics such as the economy, pollution in the air, energy consumption, and renewable energy sources.

This inquiry was sparked by a critical analysis of how SSA states may acquire domestic resources and use them to promote a fairer distribution of wealth in the domestic community. To begin, there is a scarcity of research that establishes a connection between ingenuity and decreased levels of air pollution. Many nations in sub-Saharan Africa have a more severe problem with environmental air pollution than other parts of the world, and this is mostly attributable to the fact that they rely heavily on fossil fuels (UNDP, 2021). The wealth of the countries in sub-Saharan Africa is heavily concentrated among a relatively small number of very wealthy

individuals, while the vast bulk of the population only gets a negligible portion of the total. The ratio of revenues to GDP in sub-Saharan Africa is still the lowest of any area on the whole planet. In conclusion, there is no consensus among development organizations on the severity of the environmental problems that exist in sub-Saharan Africa. Because of this, a number of countries in the region have begun experimenting with eco-innovations as a method of finding a solution to the issue (IMF, 2021; World Bank, Africa's Pulse, 2022). In order to accomplish this objective, it is necessary to provide conditions that are amenable to innovation and investment, which, in turn, will encourage the growth of the economy and the development of new market niches.

Definition of Terms

Climate change - The progressive shift over the course of time in a region's average temperatures as well as weather patterns is referred to as "climate change," and it is referred to by the phrase "climate change." It's possible that when you hear someone talk about "climate change," they're referring to a particular region or the climate of the entire planet. It's possible that as the climate changes, it will become more difficult to accurately predict weather patterns. Because of these unforeseen weather patterns, it may be challenging to maintain and produce crops in regions that are dependent on farming. This is because the temperatures and rainfall levels that were previously forecast cannot be relied on anymore. Climate change has been connected to a variety of different types of severe weather, including hurricanes that occur more frequently and are stronger, floods, heavy rain, and winter storms. The terms "climate" and "weather" are often used interchangeably. In contrast to weather, which may vary from day to day or year to year, climate is assessed over far longer time scales. Climate is measured over a long period of time. A region's climate may be broken down into its individual seasons' typical temperatures, amounts of rainfall, and wind patterns. Various locations each have their own unique climate. An example of an environment that is considered to have an arid climate is a desert. This is due to the fact that very little precipitation, in the form of rain or snow, occurs there throughout the year. Tropical climates have high temperatures and a lot of

humidity. Temperate climates, on the other hand, have warm summers and colder winters.

Green Growth- The process of encouraging the expansion of the economy without putting the natural capital that supplies important resources and environmental services in jeopardy is what is meant by the term "green growth." To accomplish this goal, it is necessary to foster investment and innovation, which, in chance, will underwrite to the maintenance of economic growth and assist pave the way for the emergence of brand new avenues of economic opportunity. The terms "green growth" and "sustainable development" are not interchangeable. Instead, it offers a versatile and workable strategy for greening the growth dynamics of economies without compromising any of the social advantages that would otherwise result from doing so. In other words, the purpose of this initiative is to make it easier to transition to a form of economic growth that is less harmful to the environment. The basic goal of any environmentally responsible development plan should be to help all natural assets reach their full economic potential in a manner that is sustainable and equitable for society as a whole. Clean air and water, as well as the biodiversity necessary for supporting agriculture and human health, are all examples of the kinds of life-supporting services that may be made available. These are both essential for keeping this potential alive. Initiatives for environmentally responsible development take into account the fact that the natural resources of our planet cannot be endlessly replenished.

Renewable Energy- When we talk about "renewable energy," we are talking to the power that is generated by resources that are constantly being renewed, such as the sun and the wind. This is the definition of what we mean when we talk about "renewable energy." This encompasses the power derived from the sun, as well as the heat generated by geothermal activity, the wind, the tides, the water, and many types of biomasses. This supply of energy is never depleted because it is continuously replenished, therefore it can never run out. The term "alternative energy" refers to any method of power generation that does not rely on conventional fossil fuels. A catch-all word for alternative energy sources that aren't the norm and have a minimal impact on the environment, green energy is a relatively new concept. Several authors compare and contrast the terms "alternative fuels" and "fossil fuels"

to emphasize the distinction between the two terms. The absence of negative effects on the surrounding environment is typically emphasized when discussing alternative forms of energy. There is a substantial difference between alternative energy and renewable energy, the latter of which may or may not have a big impact on the environment. Alternative energy is distinguished from renewable energy by this contrast.

Environmental Regulations-Legislation pertaining to the environment was enacted with the intention of shielding humans and ecosystems from the pollution that was caused by industrialization and urbanization. According to RAND's research, regions of the world where the cost of complying with environmental regulations is high, public awareness of the health risks of noncompliance is low, and trust in the data used to create the regulations is low require the development of methods for collecting interpretable, quantitative information about the costs and benefits of environmental regulations.

Economic Growth- I won't bother citing a specific source because the concept of economic growth is described in a number of different ways, one of which is "an increase in the number of goods and services produced per head of the population over a period of time." Because there are so many magazines currently available, I am unable to choose which one to use as a reference. According to the Oxford Dictionary, economic growth occurs when the quantity of output increases relative to the number of people in a certain area and time period. This increase occurs over the course of a certain period of time. In addition to that, you may seek up a relevant term in the Cambridge Dictionary. According to the definition presented above, growth is "an increase in a nation's or region's economy, particularly in the value of products and services generated by the nation or territory." Additional clarifications can be found in the footnote that follows. Taking into account both of these definitions as well as the body of economics research as a whole, I present the following: When there is economic growth that results in a society possessing a greater quantity and/or higher-quality of products and services we speak of economic growth. Due to the fact that GDP is used to quantify economic expansion, my requirements are best met by a definition that takes into account a wider range of possibilities than is often understood. To make better use of the available space, refer

to "products" rather than "goods and services," and refer to "value" rather than "breaking down price and quality into its basic pieces." As a brand-new product is introduced to the market, the change in the quantity that occurs when the count begins to increase from zero to one is the single most significant shift. New things and services such as, such as those brought about by medicine, vaccines, computers, and the telephone, are sometimes responsible for the most significant shifts in the historical trajectory.

Financial Development- Is the expansion of banking systems and stock markets and financial instruments all at the same time. The steadily increasing effectiveness of financial operations as a result of the broadening of the scope of financial contacts and the ongoing process of upgrading the commercial sector. It is shown in the eradication of financial repression as well as the enhancement of financial structures, the creation of fiscal devices, and the diversification of economic organizations in order to react to economic progress. It entails getting around the "costs" that are borne by the financial system. As a result of this process, which made it cheaper to get information, enforce contracts, and do business, financial contracts, markets, and intermediaries were created.

Air Pollution- The term "air pollution" refers to the condition in which the atmosphere contains particles or substances that are toxic to living things, including humans, animals, and plants. Additionally, it can cause structural damage to structures. There are a large array of hazardous pollutants dispersed throughout the air. They might take on any shape, from molecules of gas to solid particles to drops of liquid; the possibilities are endless. There are a number of potential entry points by which pollutants might make their way into the atmosphere of Earth. Air pollution is brought about by several things, including factories, cars, airplanes, and spray cans; nevertheless, people are mostly to fault. It is regarded to be a contributor to the problem of air pollution when another person breaths in smoke from a cigarette. These types of pollution are also referred to as anthropogenic causes of contamination. There is a natural occurrence of certain forms of wildfire smoke, volcanic ash, and other forms of air pollution. The term "natural sources" refers to these many kinds of resources. Large cities often have more severe air pollution than smaller ones because of the higher concentration of pollutants that come from a

variety of sources. It's possible that the only thing that can stop the spread of air pollution are mountains and other large constructions. Because it appears in the sky as these cloud-like forms, pollution in the air frequently gives the impression that it is foggy. Smog is the common name for this substance. The terms "smoke" and "fog" were first combined in the modern-day word "smog." Major cities in economically developing or impoverished nations often have significantly higher rates of air pollution than large cities in wealthy ones. Karachi, Pakistan; New Delhi, India; Beijing, China; Lima, Peru; and Cairo, Egypt are among the most polluted cities in the world, according to the World Health Organization (WHO) . On the other hand, air pollution is an issue in a significant number of wealthy nations. Smog City is a frequent nickname given to Los Angeles, which is the most populous city in the state of California. This nickname comes from the city's notoriously high levels of air pollution. The majority of people think of pollution in the air as being caused by emissions from huge companies or cars. On the other hand, there are a great number of additional forms of air pollution that may be present in enclosed places. To heat a home using fuels that produce pollution, such as kerosene, wood, or coal, can make the air within the home unhealthy to breathe. Ashes and smoke not only make it more difficult to breathe but also have the potential to cling to surfaces, foods, and clothing. Radon gas is a naturally occurring gas that has been linked to cancer and has the potential to accumulate to hazardous levels in dwellings. Radon can enter the atmosphere if it breaks free from the earth's crust and travels high enough. With the assistance of low-cost equipment installed by trained professionals, it is feasible to lessen one's exposure to radon. Insulation and other building materials may provide risks to people's health if they are used in construction. Another factor that encourages the growth of harmful mold inside of buildings and other enclosed places is the lack of ventilation, often known as air movement. It is possible for a single colony of mold to flourish in the walls of a house or in any other damp, chilly, and dark location, such as a basement or a closet. When mold spores are discharged into the air, they have the potential to swiftly spread throughout a home. People who are more sensitive to the sickness may become ill if they inhaled the spores.

Fossil Fuel- Fossil fuels are produced when inorganic stuff, such as dead plants and animals, undergoes decomposition over long periods of time. Both carbon and hydrogen, which may be burnt to produce energy, are thought to be present in the

crust of the planet, and both of these elements have the potential to be used as fuels. Fossil fuels include things like coal, oil, and gas, amongst other things. When looking for coal, sedimentary rocks are one of the most typical places to look. The stratigraphy of these deposits provides evidence of the existence of both rock and dead plant and animal life, as shown by the composition of the sediments. A large portion (greater than fifty percent) of a coal lump's bulk must have originated from long-dead plants that were petrified. In the beginning, oil was discovered as a solid that had been trapped between layers of sedimentary rock such as shale. Shale is one example of this type of rock. This chemical is heated to a temperature high enough to change it into a viscous oil, which is then used in the construction of gasoline. In most cases, natural gas is located in pockets that are located on top of oil reserves. In addition, it is possible that it will be found in the strata of sedimentary rock that do not contain oil. Methane is the natural gas component that occurs in the greatest quantity. Coal, oil, and natural gas, among other fossil fuels, provide 81% of the energy used in the United States, as reported by the National Academies of Sciences. These fuels make up the majority of the country's energy supply. Buildings, transportation, and industry are heated using the energy derived from this source, and it is also utilized to supply the general population with electricity. It is too unrealistic to wait millions of years for new coal, oil, and natural gas supplies to develop since fossil fuels are a resource that does not regenerate. In addition, the combustion of fossil fuels is responsible for about 75 percent of all emissions that have been produced by human activity over the course of the previous 20 years. Scientists and engineers are now working at ways to cut down on the amount of fossil fuels we use as well as ways to make the burning of fossil fuels safer and less damaging to the environment. They are especially concerned about implementing measures to reduce emissions of carbon dioxide. Scientists from all around the world are devoting a significant amount of their time and energy into the quest to discover answers to the challenges posed by fossil fuels. They hope that in the future, there will be sufficient fuel, and they hope that the environment will be healthy enough, to allow for human existence and labor to be sustained. The Department of Energy in the United States is now conducting research on technology that will make it possible for natural gas-powered automobiles to be sold commercially. They are also focused on finding strategies to lessen the damage that coal power stations and oil wells do to the surrounding ecosystem. Researchers at Stanford University in California have been

applying more environmentally friendly technology in an effort to find a way to burn fossil fuels while simultaneously decreasing the harmful consequences on the ecosystem of the surrounding area. Switching from coal to natural gas, which is responsible for approximately half the amount of carbon dioxide emissions, is one viable solution. The Stanford group is also working on a technology known as carbon capture and sequestration, which involves extracting CO2 from the air and storing it in subterranean reservoirs. This is one of the methods they are researching. The University of Bath in the United Kingdom and Stanford University in the United States are attempting the unthinkable by combining carbon dioxide and sugar in an effort to produce a plastic that is environmentally friendly.

CHARPTER II

Literature review

Introduction

In this chapter, we examine the empirical theories that attempt to explain the links between factors such as air pollution, green growth, the utilization of renewable energy, and financial development. This portion also depends on studies that have been carried out in the past as well as those that are now being carried out for the goal of stressing and examining the connection between the various components. Empirical theories pertaining to air pollution were also investigated as a means of generating hypotheses that could be helpful in estimating and evaluating the underlying correlations that existed between the independent variables.

Theoretical Literature Review

Several researches have shed light on the intricate nature of the connection that exists between human economic activity and the natural world. Plans for future development have to take into account environmental preservation, despite the fact that raising overall living standards and providing more opportunity to more people are unquestionably vital goals (Albu, 2018; Ndubisi et al., 2019). If economic advancement was achieved at the expense of environmental and social well-being, it would have a cataclysmic impact on future generations (Ndubisi et al., 2019). We run the risk of creating a game with a negative sum if we are unable to properly manage the resources of the world, particularly those that cannot be replaced. In such a game, the sum of our gains and losses is negative, and the generation that follows us will be the ones who suffer the most as a result. These are the very people for whom we hope and work to make the world a better and safer place in the future. The objective of sustainable economic development is to increase economic prosperity while simultaneously supporting social progress and safeguarding natural resources (SED). This strategy is helpful for businesses, society, and the environment, earning a win-win-win rating (also written as +, +, and +). It's a good way to pass the time while coming out ahead. Components of sustainable economic development include employment and decent work, high-quality education and

retraining of employees, income increases, increases in production and earnings, responsible consumption and production, innovative and profitable ventures, environmental protection, resource conservation, societal advancement, and economic growth (Ndubisi et al., 2019). In certain situations, sustainable economic development can only be achieved by the efficient use and distribution of ever-dwindling natural resources, as well as the accumulation of wealth geared toward the enhancement of the well-being of humans (Balisacan et al., 2015).

Empirical Literature Review

To restate what has previously been stated, the economies of Asian countries have been expanding at rates that are unparalleled. Nevertheless, expansion at such a rate is seldom capable of being maintained. The majority of Asia is afflicted by a serious mismatch between financial prosperity and social advancement, sometimes known as growth in a sustainable economy, which is a word that incorporates but is not limited to monetary growth. This disconnect is frequently referred to as a "double dividend" (Stough et al., 2011). For developing countries, putting an emphasis on economic growth is very necessary; yet, in order for this prosperity to be sustainable, it must be generated and distributed equally across the whole Community.

One of the primary reasons why Asia is considered to be one of the richest regions in the world is due, in large part, to the robust ecosystem of medium-sized businesses that can be found there (Harvie and Lee (2005); Ndubisi (2008); Budhwar et al. (2016). One cannot overestimate the significance of Asia's many micro, Nano, and micro-sized enterprises (SMEs) to the overall growth of the continent's economy. There are many different ways that small and medium-sized businesses, sometimes known as SMEs, contribute to the growth of the economy. One strategy that may be used to accomplish this goal is the export of goods that are manufactured in certain nations. The creation of new employment, the equitable distribution of existing resources, and the alleviation of poverty are a few further choices. The development of an entrepreneurial spirit and the introduction of specialized production methods that are beneficial to regional economies are two of the most important characteristics that set today's small and medium-sized firms apart from their larger counterparts (SMEs). There is no possible way to look at any of these improvements

and not conclude that they are good to the economy of rural areas (Tambunan, 2009; IFC, 2010). The term "small and medium-sized manufacturing enterprises" (SMMEs) refers to the businesses in Asia that are the primary force behind the region's thriving manufacturing sector. They are also a significant factor in the county's efforts to gratify the mounting demand for products and services, which depends largely on them. The growth of their economies and cultures may be directly attributed to the achievements of their nation's small and medium-sized businesses in several of Asia's growing nations (Zeng et al., 2011). As a result of the significance of this sector to the expansion of economies throughout Asia, it is essential that SMMEs contribute to the improvement of the countries' performances in international competition. You should make it your mission to provide the impression that your country is one of those whose pasts demonstrate that the global market has rewarded it for the importance of small and medium-sized enterprises (SMEs) to economic development and to the maintenance of long-term sustainability (Harvie and Lee, 2005).

Not only did empirical investigations prove that human energy use had a significant and detrimental effect on the environment, but they also presented their findings and arguments within the EKC. According to research conducted by According to Bhattacharyya (1981) and Ramanujam and Saaty (1981), (2011), amongst others, greenhouse gas emissions are lower in emerging nations as a result of a decreased usage of energy. Jayanthakumaran and his colleagues (2012) investigated the state of affairs in both China and India with the use of the ARDL. According to the findings of the study, both China and India's use of energy led to a rise in their CO2 emissions. A fresh explanation for environmental pollution was provided by Omri (2013), and it is based on a model of simultaneous equations. According to this explanation, energy has a one-way impact on environmental pollution. In a similar manner, Tang and Tan (2015) employed causality analysis to widen the scope of their investigation to include Vietnam and discover that energy consumption was a component in pollution. They also came to the conclusion that pollution was caused by energy consumption.

Studies conducted by Mesagan (2015) and Mesagan et al. (2018b) in Nigeria and South Africa, respectively, provided evidence that an issue with energy-driven pollution does exist in both countries. Rafindadi and Usman (2019) discovered, via

the utilization of structural breakdowns, that the correlation between the two is clear might be either elastic or inelastic. The Maki-co-integration test was incorporated into the CRR and FMOLS frameworks, which allowed for the successful completion of this task. Mesagan and Olunkwa (2020) discovered, via the use of a panel analysis, that the use of energy in Africa has a substantial effect on the region's level of pollution. Recent research conducted by Xu and colleagues (2021) utilized the STIRPAT framework in order to evaluate the situation in China. In spite of the fact that it was demonstrated that energy created from coal was to blame for a sizeable quantity of sulphur pollution, it was also proposed that power generated from natural gas may assist in reducing the severity of the issue.

Some of these studies were the first to demonstrate a substantial relationship between energy use and financial progress. Sadorsky (2011), for example, employed a dynamic panel architecture to discover that financial success had a positive and considerable influence on energy use in the manufacturing industry. This theory is supported by research carried out in two studies, one conducted in Pakistan by Shahbaz et al. (2013) and the other in Germany by Rafindadi (2015), found evidence of a positive feedback effect between rising energy use and burgeoning economies. In a similar vein, Rafindadi and Ozturk (2016) utilized the ARDL method to determine that industrialization significantly increases a country's energy consumption. The researchers arrived at their conclusions after seeing a correlation between learning about the financial sector and learning about the energy industry, which in turn led to the discovery of the environmental repercussions of pollution. Evidence suggests reduced pollution in China as a consequence of its economic growth, say Feridun and Jalil (2011) of the ARDL school of thought.

In a similar vein, the collective efforts of Shahzad et al (2017) conducted study on the topic in Pakistan using a quantitative approach and found that economic expansion reduces pollution over time. This was shown to be the case in both the short term and the long term. In the end, this is the conclusion that they reached as a result of their investigation. In addition, the research demonstrated that there is a feedback effect between rising economic activity and rising energy consumption, as well as a unidirectional causal connection between these factors and rising CO2 emissions. Nasreen et al. (2017) carried performed study in South Africa with an approach somewhat dissimilar to our own. They were surprised to find that long-

term pollution was worsened by increases in manufacturing and energy usage, whereas decreases in pollution were caused by increases in financial stability. However, Katircioglu and Taspinar (2017) used a dynamic ordinal logistic regression (OLS) and included interaction components into the model in order to make the methodology applicable to Turkey. This allowed the methodology to be used successfully in Turkey. It was shown that growth's short-term effects on pollution were adversely influenced by financial development, whereas growth's long-term consequences on pollution were favourably affected by financial development.

The researches that Mesagan and Nwachukwu (2018) conducted into the Nigerian setting provided the basis for their conclusions. In spite of the fact that excessive vigour intake was shown to be associated with the deterioration of the environment, the researchers also found that it did not cause or contribute to the growth of the national economy. Research shows that, two primary segments donating significantly to environmental degradation are the energy sector and the banking sector. Reducing carbon dioxide emissions requires better living conditions and smarter energy usage, as shown by the research of Charfeddine and Kahia (2019) and Salahuddin et al. (2018). Researchers Yin et al. (2019) employed a recently developed method for disaggregating pollutants and came to the conclusion that China's fast economic expansion has led to an improvement in the country's water quality. In spite of the fact that national SO2 emissions are increasing, this was shown. Researchers used cutting-edge tools in order to make this ground breaking finding. According to the findings of Ehigiamusoe and Lean's (2019) investigation of a bigger sample size that consists of 122 countries, both of these are associated with greater levels of pollution on a worldwide scale. Instead, they discovered a correlation between a reduction in pollution and economic progress in countries with high levels of affluence. This led to a rise in the amount of pollution in nations that were still in the process of developing.

It has been demonstrated that growth in the financial area has only a marginal influence on Carbon Dioxide Emissions; but, when combined with advances in information and communication technology, this factor contributes to a reduction in pollution in the G7 nations (Raheem et al., 2020). Ibraheem (2020) came to the conclusion that an increase in income as well as pollution were two factors that contributed to a deterioration in the natural environment in Egypt as the country's

economy grew. Studies such as Mesagan (2021b), Magazzino et al. (2021a, b, c), and Mele et al (2019) are some instances of study that have associated energy use to other factors. Other studies include Karatasou and Santamouris (2019). (2017). Examples of study that have linked energy use and other aspects may be found in Magazzino (2017), Kazak et al. (2018), and the papers relating to both of these researchers (2021). Magazzino (2017) investigated the changes that occurred between 1960 and 2014 in the Italian financial sector, income, the price of oil, and energy use. According to the research results, greater oil prices and income led to higher energy consumption over the course of a longer period of time, but higher oil prices and financial development led to a negligible increase in energy consumption over the course of a shorter period of time. In Poland, Kazak and colleagues (2018) discovered a correlation between the use of energy and a number of different indicators of sustainable development. The findings indicated a relationship that was statistically significant between the sewage treatment plants of households, the amount of flat usable area, the amount of municipal waste collected, and the amount of electricity that was consumed. This was especially true in semi-rural and rural areas. This research highlights how important it is for individual homes to reduce their energy use in order to achieve sustainable development that is both ecologically responsible and socially fair.

Karatasou and Santamouris (2019) used a latent regress or method to conduct an analysis on the association that exists in the United States of America between RE and economic position. Energy consumption may be decreased by increasing the total number of occupants of a property, but a person's socioeconomic position, which can be determined by the number of privately owned depending on the number of bedrooms and bathrooms, has a far higher impact on RE. Two groups of researchers, Mele et al. (2021) and Magazzino et al (2021b), respectively, conducted research in Italy and Germany with the purpose of determining whether or not there is a correlation between increasing economic activity and deteriorating environmental quality. Mele et al. (2021) employed a technique of machine learning to estimate future increases in Italy's carbon emissions, even though the country was going through a period of slow economic development at the time. This was accomplished despite the fact that Mele et al.(2021) using a quantum model of machine learning, Magazzino et al. (2021b) found that while biomass energy

contributes greatly to the reduction of CO2 pollution, wealth and the growth of renewable energy technology are the primary contributors to pollution in Germany.

After that, Magazzino and his colleagues (2021a, b) conducted research on the function of information technology in the workplace and gathered their findings (ICT). Machine learning was used by Magazzino et al. (2021a) in order to examine the correlation amongst increasing GDP and increasing energy intake in OECD nations. It was shown that ICT, which stands for information and both of these issues were greatly influenced by advances in communication technology. This research contributes to the increasing body of evidence that links rises in wages to increases in electricity consumption, or that accounts for a significant portion of global warming pollution. Magazzino and company conducted in-depth study across all of the countries that make up the European Union (2021b). It was established that industrial expansion has a major impact on power use; nevertheless, there was no statistically significant association related to the relationship between energy use or ICT use and emissions of greenhouse gases. In the end, Mesagan (2021b) used the system GMM framework to investigate the problem in Sub-Saharan Africa from both manufacture and use points of view. The findings of the empirical investigation demonstrated that the manufacturing industry was responsible for a considerable amount of the environmental damage that was seen.

Wang et al. (2017) conducted research and conducted an analysis on the effectiveness and potential for reducing CO2 emissions in APEC member nations. The authors came to the conclusion that APEC members with lower energy intensity were more likely to have worse energy performance as a result of the substantial negative connection that existed between energy performance and energy intensity once it was established that there was such a link. In addition, greater patenting efforts, along with a drop in energy intensity brought on by adjustments in input cost, contribute to a general reduction in the amount of energy that is utilized. In order to assess the imaginable energy decrease possible the promotion of net-zero energy buildings in the Asian and Pacific region, Zhang et al. (2020) conducted an analysis of a bulky sum of case revisions. According to them, substantial link exists amongst the amount of energy used and the GDP that is generated per person, and all climatic zones are practically the same. Zhou et al. (2017) investigated whether or not there was a correlation between the energy mix of APEC nations and their energy efficiency as well as their congestion assessment.

According to the findings of the researchers, greater levels of energy consumption and industrial value added relative to GDP led to congestion, whereas lower levels of GDP per capita contributed to a reduction in congestion. Growing economic development is often contingent on improvement in the use about resources that are not replenish able fossil oils, which are detrimental to the health of the atmosphere, pose a risk to the exhaustion of natural resources, and contribute to the phenomenon of global warming (Pettinger, 2020). When a particular level of economic growth is attained, it helps to ensure the long-standing viability pertaining to the natural world by increasing people's earnings and, as a consequence of this, the demand for renewable resources (Zaidi et al., 2019a).

Examining the Gross Domestic Product (GDP) expressed as a percentage of the total means of production, generation, and distribution of energy is one way to evaluate the extent to which energy efficiency has improved throughout the world. The global community is now behind schedule in terms of meeting the Sustainable Development Goal objectives related to energy by the deadline of 2030 that was established by the United Nations. Goal No. 3 of the Sustainable Development Agenda (SDG) is to ensure that all people have access to low-cost energy sources in order to combat environmental issues. Goal 3 of the Sustainable Development Goals especially strives to lessen the negative effects that air pollution has on people's health. The Sustainable Development Scenario that was developed by the International Energy Agency (IEA) illustrates how a primary energy system may evolve and provides measures that can be taken to achieve these Sustainable Development Goals (IEA, 2020b). Greater energy intensity and broad access to energy have both contributed to an expansion of economic prospects; yet, these factors have also worsened a worrisome trend in terms of ecological sustainability (Otto von Troschke, 2015). Poor air quality has emerged as one of the most pressing environmental issues of our day as a direct result of the vast variety of detrimental consequences it has on human health (Hoq et al., 2019; Soleimani et al., 2019). One of the most critical issues affecting the environment today is air pollution, which may have potentially catastrophic repercussions on people's health. When potentially hazardous compounds are discharged into the atmosphere, this results in air pollution, which endangers not only the health of individuals but also the capacity of ecosystems to function correctly over time. The poor quality of the air has long-term repercussions on human health, including an increased chance of sickness such as pneumonia, heart

disease, lung cancer, and stroke. These ailments all contribute to the already alarmingly high death toll around the globe to wit: (Yamamoto et al., 2014; Zhang et al., 2014).This idea has been shown to be supported by data from a variety of research, some of which were even published by the WHO (2014). Several studies have shown this to be the case (Ghorani-Azam et al., 2016; Di et al., 2017).

According to data compiled by Health Organization in the World (WHO), mortality and illness rates have skyrocketed over the last several decades, particularly in countries that are not considered to be highly industrialized. This problem has become worse in part owing to the pollution of the air both indoors and outside (WHO). In 2016, dangerous levels of air pollution were directly responsible for the deaths of around 4.1 million young people; more than 90 percent most of these fatalities occurred in low- and middle-income nations (World Health Organization, 2018). That's why it's crucial that keep in mind that those in existence in industrialized nations are not immune to the consequences that air pollution may have on their health. For example, more than half of all Americans are exposed to potentially hazardous levels of particle and ozone pollution, which may lead to major health issues and even death at an earlier age (MacMunn, 2018). According to statistics provided by pollution, WHO, and human health was a contributing factor in more than half of all premature deaths that occurred in the year 2016. Problems with the respiratory system and the cardiovascular system were responsible for a disproportionate number of these deaths (World Health Organization, 2018). Short-term effects of being in a location with high levels of air pollution include things like sneezing, headaches, confusion, and irritation in the eyes, to name just a few of the symptoms (Nunez, 2019). Recent research has also shown a relationship between high levels of air pollution and an increased likelihood of sterility According to many studies (Gaskins et al., 2019; Choe et al., 2018), this is the case. "Choe et al" (2018), to provide just one example, discovered that the risks of preterm delivery and infertility were significantly higher among females who were surrounded by much polluted air. These findings are given further weight by the observation that a higher propensity to smoke is shown in females who are often exposed to high levels of overall environmental air contamination.

In many of the world's most influential cities, poor air quality has been a major environmental problem since the beginning of the industrial revolution. Numerous research have pointed to a connection between increased development and

deteriorating the standard of the air (Wang et al., 2020a; Larkin et al., 2016). Urbanization is associated to a wide variety of adverse effects, some of which include increased usage of fossil fuels, industrial pollution, and energy needs, as well as social and economic activity, and degradation of carbon sinks. As a result, the heights of air cities polluted are often developed than those in the natural ecosystems that are located nearby (Wang et al., 2020a; Yang et al., 2018). In most cases, accepted that one of the key reasons of the worsening air quality in large cities is rapid urbanization, which has already reached 3.9 billion people and is expected to reach 5 billion by 2030 (UN Population Fund, 2020). Several research provide credence to this viewpoint. It in the past shown that rapid urbanization has a growing impact on a variety of particle matter 2.5 (PM2.5) and other air pollutants; therefore, multiple pieces of study have pointed to a link between the two (Wang et al. 2020a; Baklanov et al., 2016; Wang et al., 2017)

For instance, Lou et al. (2016) found that for every one percent increase in population density in the Yangtze delta area of China, the concentration of PM2.5 rose by a maximum of 0.17 percent and by a daily average of 0.21 percent. This was found to be the case in China. An evaluation of Megacity air pollution and emissions was carried out by Gurjar et al., 2008, and their findings showed that 72.2% of the world's megacities have poor air quality, while only 27.8% have air quality that is statistically significantly higher. As a logical fallout of population pressures, both the quality of the natural environment and people's health are deteriorating at an alarming rate (Gurjar et al., 2016). In the worst of these situations, this has caused individuals to die and has made existing health problems more wrse.

According to study, there has been a 1.4 million increase in the number of fatalities that may be ascribed to air pollution since the year 1990. (Ritchie, 2019). This increase may be directly attributed to the growth and grading of the world's population. According to one idea, the environment starts to deteriorate as soon as a developing economy starts to experience growth because of the size and composition implications (Balsalobre-Lorente et al., 2019). The early phases of emerging economies are characterized by a boom in demand for fossil fuels, which has a detrimental impact on the environment. This is a result of industrialisation, which itself has a destructive effect on the planet. However, once progress in the economy reaches a certain level, the technique effect begins to take effect, making trade-offs between economic expansion and ecological damage null and invalid. This is

because the technique effect reduces the amount of environmental damage caused by economic growth (Tenaw and Beyene,2021). The EKC theory hypothesizes that there is a reverse U-shaped link between growing affluence and increased ecosystem health, and our data lends credence to the hypothesis (Grossman and Krueger, 1991). The use of natural resources for economic gain, the development of innovative technologies, the proliferation of ideas around the globe, the accumulation of Capital, both human and monetary, and the expansion of economies are some of the numerous variables that have the potential to influence environmental quality. The treadmill concept of production, in addition to endogenous development, the globalization theory of growth may be used to describe the relationship that exists between technological advancement, the cultivation of natural resources, the expansion of international commerce, and the improvement of ecological conditions. According to the production treadmill theory, there is a direct correlation between the use of natural resources to create economic output and the resulting ecological degradation (Lewis, 2019). On the other hand, expanding the ecological footprint numbers as a result of the use of certain natural resources, particularly main sources of fossil fuels, might have severe consequences for the ecosystem (Havranek et al., 2016). Take, for instance: (Shen et al., 2021; Udi et al., 2020). Natural resources that are beneficial to the environment, such as those that do not pose a risk to human health, might potentially assist reduce the ecological footprints of human activities (Balsalobre-Lorente et al., 2018; Li et al., 2019).

According to endogenous growth theories (Ahmad et al., 2021b; Wang et al., 2019), economic and environmental well-being may be reached concurrently by investing in research and development. Technological advancement may also serve as a catalyst for economic and industrial restructuring in order to improve the efficiency with which natural resources are used in developing nations. The shift from dirty to clean energy resources is made possible by technical progress in the energy industry (Davidson, 2019), which reduces emissions associated with energy consumption to a great degree. Public R & D funding for clean energy production has been recognized as a means of improving environmental well-being (Ahmed et al., 2021). In keeping

with this idea, technical innovation may assist emerging countries in reducing the rise in their ecological footprints via the transition to clean energy.

In spite of the fact that this may be the case, a rising corpus of research (Chang and Lee, 2010; Gurgul and Lach, 2014; Chang and Lach, 2014) focuses on how different kinds of globalization contribute to national development while having varying effects on the natural world. As an example, globalization of trade motivates nations to raise their value-added production by engaging in more international business. However, the environmental implications can be very different depending on which business partners you choose. The majority of individuals hold the opinion that nations that have more severe environmental rules will exploit those nations that have less state-regent restrictions (which are often developing nations) (which are usually the relatively more developed countries). It is also crucial protection the mind that nations that import big quantities of fossil fuels tend to become net exporters of items that cause a great deal of pollution. This is something that should be kept in mind. There is a strong possibility that the globalization of trade will have detrimental effects on the ecosystems of these nations. As a result of this, nations that do not depend significantly on fossil fuels may achieve success in the global economy by becoming specialists in environmentally friendly items and exporting such commodities.

It is believed that increases in human capital have an effect on the natural environment as well, particularly via increases in expenditure on health and education (Yao et al., 2020). For instance, the growth of human capital may result in an increase in people's knowledge of environmental concerns, which may then lead to the adoption of more environmentally friendly shopping behaviors. It is possible that users of energy may be convinced to convert to cleaner energy sources and their environmental effect could be lessened if investments were made in education (Murshed, 2022). As a consequence of this, there is the potential for a large decrease in the rates of environmental deterioration caused by consumption. Investments in human capital have a direct correlation to improvements in environmental protections (Gürlük, 2009; Ahmed et al., 2020b). To put it another way: Human capital is critical to the innovation process, as proposed by the endogenous growth hypothesis (Romer, 1990).

In turn, technological advancements that are made feasible by an increase in human capital could be beneficial to the environment. Finally, the health of an economy's financial system is noted as a significant indication of the economy's contribution to the health of the environment. Even if it is believed that a defective financial system would stimulate economic development, it may wind up having the opposite effect and lowering the quality of the environment instead. Companies who are responsible for substantial quantities of pollution in developing nations may find it simpler to get financing through the financial systems of these nations because of their lack of sophistication. Green financing for companies who are eager to make investments in energy-efficient manufacturing techniques and equipment may gain from a highly developed monetary system (Bui, 2020). The growth of the economy may also be of critical importance in terms of providing funding for research and development projects that attempt to generate technology that will improve the status of the environment. This information comes from Jahanger and his colleagues (2021).

As recently as a few years ago, researchers and politicians focused more on environmental sustainability and the availability of resources. When it comes to environmental deterioration, Ahmad et al. (2020) looked at twenty-two rising economies between 1984 and 2016. When it comes to ecological well-being, restoring natural resources with cutting-edge technology might be an appropriate way to reduce environmental degradation levels in selected growing economies. The authors stressed that the bigger iconological footprint is due to resource use. Using data from 1980 to 2016, Erdogan et al. (2020) analyzed the ecological footprint of 23 countries in Sub-Saharan Africa and found that rising use of natural resources was to blame. Authors claim that poor and inefficient resource management is to blame for Africa's deteriorating environment.

In contrast to the findings of these other pieces of study, Danish et al. (2020) discovered that in the case of the BRICS countries, there is an inverse connection between the use of natural resources and an environmental footprint. [Citation needed] [Citation needed] The results indicate that emerging nations may provide the global community with significant benefits by carefully managing the natural resources that they possess. In addition, the researchers discovered evidence indicating that transitioning to cleaner sources of energy is essential for reducing

ecological footprints. This finding suggests that avoiding the extraction and use of polluting energy resources may assist in accomplishing this objective. According to Kongbuamai et al. (2020), the ecological footprints of various emerging countries in Southeast Asia decreased between the years 1995 and 2016; this finding confirms the use is the sum total of the earth's natural resources beneficial to the overall health of the ecosystem. For example, studies have shown that growing countries have quite different correlations between their natural resources and their ecological footprints. The example that is going to be used to show this idea is as follows:

Globalization is a double-edged sword that may or may not have negative effects on the natural world, according to meta-analyses of previous investigate the connection between globalization and the ecological footprints of developing countries. According to Kirikkaleli and colleagues' findings, globalization is to blame for Turkey's growing negative impact on the environment (2021). In a manner that is analogous to what we observe here, Sabir and Gorus (2019) came to the conclusion that the growing economies of South Asia have larger ecological footprints as a direct result of increased globalization activities, which has led to a decline about the state of the ecosystem. Ibrahiem and Hanafy (2020) found that as a result of globalization, Egypt's ecological footprint shrunk when they compared data that was collected on an annual basis from 1971 to 2014.

Researchers Saud et al. observed that nations participating in the Belt and Road Initiative had a reduction in the same magnitude of negative long-term environmental consequences (2020). This research has found that of study carried out by Ulucak et al., the regions that are experiencing the greatest levels of financial globalization are also the regions in which there has been Improvements in the State of Nature (2020). Research conducted by Yilanci and Gorus (2020) on 14 MENA economies reveals that differences in ecological footprint levels across these nations may be accounted for by financial globalization, but not by economic or trade globalization. Doytch (2020) asserts that developing countries do not have the stringent environmental regulation that is essential to prevent the entry of damaging FDI. It is his contention that globalization in the financial segment has brought about an upsurge in the negative effects that underdeveloped countries have on the surrounding environment.

There has been some research done to investigate whether or not there is a link amongst better real revenue and worsening ecological conditions. They were able to do this by using the cutting-edge EKC theory developed by Grossman and Krueger (1991). The economic success of a nation has been demonstrated to capacity to regulate its ecological footprint increases as its economy expands. However, it was far more difficult to do so in a country's formative years when it was still less well-established, which lends credence to the EKC theory. Decision No. 76 Concerning the Distribution of Resources in Case 1025695 (2022) Yasin et al. (2020) found support for the EKC hypothesis for a panel of rising countries throughout time by using using one's ecological footprint as a surrogate for environmental health and the Generalized Method of Moments (GMM). This information was obtained by using an ecological foot print.

Despite the fact that the EKC theory elasticity expectations value for the squared component of economic growth to be much lower, Zeraibi and colleagues (2021) discovered that as the economy grows, so too does its ecological footprint. This was discovered despite the fact that the EKC theory predicted elasticity value to be much lower. This conclusion may be directly attributed to the EKC hypothesis. The EKC theory, on the other hand, has been the subject of criticism in the past, and some people claim that it cannot be uniformly applied to all economies. According to the findings of this study, if economic expansion continues, it is possible that the ecological footprint may increase rather than decrease. The EKC hypothesis of ecological footprint is disproved by financial and industrial activity has a U-shaped progress and eco-friendly deprivation in Tunisia, as stated by Ajmi and Inglesi-Lotz (2020). Because of this, the EKC theory is invalid, and one cannot use it to explain the situation in Tunisia. The EKC hypothesis is invalidated by the existence of data that points to a U-shaped connection between the monetary extension of China and India and the effect that this expansion has had on the environment. In addition, Yilanci and Pata (2020) discovered that the EKC hypothesis was false in China, which is equivalent to the findings in the Western world. The findings of their investigation were published at the same time.

Danish et al. (2019) studied the link correlation between human resources and economic output development and EF in the context of developing nations by using

annual data from Pakistan between 1971 and 2014. Their research focused on the years 1971 through 2014. According to the findings, the growth of human capital can only bring about decreases in the country's ecological footprint projections during the course of the near term. Increasing people's understanding of the negative effects of environmental degradation might be one of the outcomes of investing in human capital via education. This would then lead to more efficient management of natural resources and a more balanced ecological system. Investing in human capital was shown to lower anticipated ecological footprints over the long term by researchers in China and South Africa, November et al. (2021) and Pata and Caglar (2021), respectively. These researchers discovered that investing in human capital reduced ecological footprints. According to Ahmed and Wang, there was also evidence that a growth in human resources led to a decreased impact on the environment in other rising nations like India. Some of these countries include India (2019).

In addition, there was no evidence found to support the existence of a causal feedback impact on ecological footprints. On the other hand, Kassouri and Altntas's (2020) study of 13 MENA nations indicated a trade-off between the growth of human capital and EF. This was one of the most important things that they learned from doing the study. The authors contend that increased levels of affluence in economic and social sectors are linked to higher levels of pressure that are placed on the environment as well as bigger carbon footprints. Therefore, it should not come as a surprise that there is a great deal of confusion about the amount of money spent on human capital and the level of impact that it has on the whole globe. This study's results suggest that conclusion that environmental issues do have an influence on economic growth, and that this impact is felt more strongly in developing countries.

To paraphrase what Yasin et al (2020), who contend that Prosperity in the economy is detrimental to the wellbeing of the setting, the rise of the commercial area may reduce the long-term ecological footprint statistics of less developed nations. These researchers argue that economic growth is bad for the atmosphere. Therefore, increasing the fiscal sector nations that are still developing is a more feasible road to environmental sustainability than expanding it in wealthier governments, the authors argued. It was hypothesized by the authors of this study that a lack of technological advancement in the commercial segment would not lead to larger conservational

footprints in developing countries. The authors reasoned that this would not be the case because the economic segments of such countries are so which means they are so undeveloped as to be unable to increase their demand for ecological resources. Although Mrabet and Alsamara (2017) found that the development of Qatar's economy did not have any immediate influence on the environment, they did uncover that it has a long-term harmful effect on the ecosystem by increasing the ecological imprint of the nation. Destek and Sarkodie (2019) carried out an analysis quite similar to this one on 11 recently industrialized countries by using the Augmented Mean Group (AMG) estimator in order to study the connection between expanding economies and ecological decline.

It seems there's a link between economic development and Environmental Footprint in Singapore, a negative relationship in China and Malaysia, and no relationship at all in India, Brazil, Mexico, the Philippines, the Republic of Korea, South Africa, Thailand, and Turkey. Singapore was the only country in which we established a link between economic development and Environmental Footprint. The reported outcomes were as varied as the participating countries themselves. In contrast to the commonly held belief, the research conducted by Naqvi and colleagues (2021) revealed that economic expansion had no bearing on the environmental damage that was caused by countries with low, lower, and intermediate incomes. The increased demand for ecological resources, which in turn has been connected to economic growth, has been linked to the rise in ecological footprints that have been left behind.

As a consequence of potential shifts in the use of resources, there is the potential for fluctuating levels of energy consumption as well as pollution. The research conducted by Rahman (2020) revealed that participation in the EU had a negative impact on the emission rates of economies belonging to the G7 and the UK. Using an ARDL typical, Shahbaz et al. (2013) investigated the amount of energy that was used in China, India, Turkey, and Indonesia. The authors of after examining the data, the researchers determined that a reduction in the use of power would cause a decrease in carbon emissions both immediately and over the long run. This occurred in each of the four countries. Destek et al. (2016) conducted a research that covered the years 1991-2011 and honed down on eleven nations in Central and Eastern Europe to assess how participation in the EU affects the levels of carbon dioxide (CO2)

emissions in those countries. The study focused on eleven countries. The findings provided some evidence to back up the hypothesis that the EKC theory may be implemented in the aforementioned countries.

Based on study results FMOLS (completely modified ordinary least squares) study, it seems that the European Union may have some responsibility for the productions of greenhouse gasses that contribute to global warming. Furthermore, Dong et al. (2017) using Granger causality and the AMG estimator to study the link between natural gas production and EU carbon emissions from 1985 to 2015, came to the conclusion, which was not the leaensureeir results, that the European Union (EU) was to blame for the growth in carbon emissions and that the two were connected. This conclusion contradicts the leaensureeir findings. Destek and Aslan (2020) employed the multivariate relationship between aggregated REC, EG, and climate change in the G-7 countries from 1991 to 2014 was analyzed using the AMG estimator and panel bootstrap causation. This study included the time period from 1991 to 2014. They did the analysis of the data from 1991 all the way up to 2014. In this particular investigation, the years 1991 to 2014 served as the focal point of attention. According to the findings of the study, for instance, increasing the use of hydroelectricity to generate electricity causes environmental damage in nations like Italy and the UK. To the contrary, the study found that increasing the use of biomass to generate electricity in countries such as France, Germany, Japan, and the United States helps reduce carbon emissions.

B'elad and Youssef (2017) conducted an investigation on renewable and nonrenewable sources of energy in Algeria. They used data spanning the years 1980 through 2012, as well as the ARDL, VECM, and Granger Causality methodologies. The findings revealed that NRE contributes to the improvement of the natural environment in a positive way. In addition, Pata (2018) found, with the use of an ARDL model, that the various types of energy sources had the quantity of carbon emissions, both positively and negatively. According to the findings of Chen et al. (2019), China was able to reduce its carbon emissions between the years 1995 and 2012 by increasing its use of coal as well as alternative forms of energy. However, the fact that energy consumption continues to rise and emissions are both essential to the operation of the economy, this fact was not stressed in the assessments.

Researchers started their investigation in 1982 and continued it until 2013. They focused on ten emerging countries and looked ahead to 2019 to see whether any of them would become pollution havens.

They evaluate the dynamic actual income and (FDI), export performance, and export growth potential by using panel data of the second generation. The environment is suffering from a rising number of adverse consequences as a result of the increased use of energy and the expansion of economic activity. In addition to mitigating the effects of climate change, a thriving economy is necessary to ensure the continued existence of the human species over the long run (Destek and Sarkodie, 2019). The growth in GDP is accompanied with an increase in carbon dioxide emissions (Ren et al., 2021). The Environmental Kuznets Curve, which was first established by Panayotou (1994) and is used by many individuals to highlight economy-wide product correlation and carbon dioxide emanations, was first produced by Panayotou (1994). (EKC). Within the parameters of this model, an inverse affiliation amid GDP and CO2 releases is anticipated to exist, and the form that this relationship is likely to take is shown by a curved U that is turned upside down.

According to the findings of this research, the rise in CO2 emissions that occurred concurrently with the beginning of industrialization may have been responsible for contributing to the deterioration of the climate on this planet. On the other hand, if a nation's economy is doing well, it will be easier for that nation to make it's the change from industrial from the pre-industrial period, which will need lower levels of CO2 emissions.

Annual data analysis was carried out by Destek, Ulucak, and Dogan (2018) utilizing methodologies from the second generation of panel data. This was done with the purpose of making up for the fact that many tribes were located in a wide variety of national settings by providing a level of equality. The time span covered by this particular study, which began in 1980 and ended in 2013, was those years. Both the habit of nonrenewable energy resources and GDP per capita in member countries EU have a connection that is shaped like a U. Erdogan et al. investigated the correlation between the developing economies of the BRICS-T countries and their rising levels of carbon emissions (1992-2016). (2019). Extensive empirical research have

demonstrated, time and time again, that there is a correlation between a growing economy and an increase in carbon emissions. Abbasi (2021) investigated the short-term and long-term correlations as a correlation between GDP and carbon dioxide emissions using both the CS-ARDL and the Dumitrescu and Hurlin Granger Causality. As a direct consequence of this, this had a role in helping to create the phenomena of cooperation across disparate groups a phenomenon that persisted over the ages. It's possible that the passage of time was the driving force behind this accomplishment.

The term "natural resources" refers to those essential for the expansion of both the economy and enterprises in order for either to occur (Ndiaya et al., 2019). In a research that spanned the years 1985 and 2016, Balsalobre-Lorente et al. (2018) looked at the ways in which the use of energy and NR affects the environmental sustainability of five different nations in Europe. An examination of panel data revealed that the exploitation of renewable energy sources and natural resources (NRs) contributes to the promotion of sustainable development. Researchers Zafar and Shahbaz, along with others, investigated the influence that the United States had on the environment (2019). Using an ARDL approach, the researchers were able to establish a relationship between them. According to the findings of the study, minimizing waste in natural resources includes retraining people's eating habits, cutting back on fishing and erosion, conserving water and power, and moving to goods that are more energy-efficient. In this study, Victor and colleagues analyzed the relationship between Carbon emissions and NR rent across that’s 16 countries in Europe (2019). They came to this conclusion by applying the PMG-ARDL methodology and found that in certain areas, NR rent is a factor that leads to pollution.

Researchers to the best of our knowledge, Shahbaz et al (2019) examined the influence of useful material availability and dependency on useful material availability on financial growth from 1980 to 2015 in 35 resource-rich countries. Their study covered the period from 1980 to 2015. They centred their study on the years 1980-2015. The findings indicated that there was a tight connection between the influencing elements. There is a positive correlation between rich mineral deposits and the expansion of economic activity, and there is a negative

correlation between the absence of these resources and the expansion of economic activity. To minimize the pace of environmental deterioration, many experts call for enabling correction of the NR in combination with the conservation of artificial resources, as seen by Danish et al. (2019), who discovered that NR is readily available in the BRICS countries causes a decline in environmental degradation. This approach makes perfect sense in light of the fact that the authors have shown that NR is easily accessible in the BRICS nations (except in India). Because newer technology recycles, reuses, and innovates in different ways than older technology does, switching from the older technology to the more current technology may have positive results in repercussions for the economy and the natural world. Recycling helps to avoid the loss of valuable resources that would otherwise be thrown away. Caglar, Balsalobre-Llorente, and Akin (2021) carried out unit root testing in both the regular and the one-break formats. They discovered that all six aspects of an ecological footprint had a apart from the footprint, unit root left by developed land in Spain and the footprint left by grazing land in the United Kingdom. The conclusions of Caglar, Balsalobre-Llorente, and Akin were presented in a publication called Ecology and Society.

An ecological overshoot is unavoidable due to the widespread view that the world population expansion that I expect to continue during the next years, as well as the equally optimistic forecasts about the growth of global consumption. Because of the anticipated rise in world population by the year 2050, a disproportionately significant percentage of the natural capital of the planet will need to be allocated (Galli, 2015). In the event that the demand for renewable materials by the world's population exceeds the conservation carrying ability of the Earth, then we will have experienced what is known as a global overshoot. The repercussions of a fast growing human population include the devastation of natural infrastructure, a fall in environmental efficiency, and a drop in carrying capacity.) (Freedman, 2014). Low-income-per-person economies are home to a greater percentage of the world's population (Monfreda et al., 2004).

However, research carried out from Toth and Szigeti (2016) demonstrates that there is a trend of consumption that develops as a direct result of an increase in Human population is the most important cause about environmental deterioration. When Begum and co. (2015) came to the conclusion that population expansion

did not have an impact that was significantly noticeable on the ecological balance of Malaysia based on a synthesis of research that was conducted in Malaysia throughout the 1970s and 1980s. According to the findings of the research, there is a possibility that a growth in their number might have a cooling effect on global warming. Research conducted by organizations such as Mendonca et al. (2020) and Dong et al. demonstrates that populations and ecosystems are inextricably linked to one another (2018). Throughout the whole of span of time that was looked into, it was discovered that the two variables maintained a solid and consistent association with one another. It was shown that people living in urban areas had a bigger impact on the environment than those living in rural areas, however the rate of increase in GDP had no noticeable affect the pace of environmental deterioration (Wood and Garnett 2009).

In a time-series study, it has not been possible to identify any relationship between the natural resources of the United Kingdom (UK), its power use, the rate of progress in the economy, the rate of population growth, or the value produced by its industries. It's possible that the samples (geographic region), timeframes, variables, and statistical procedures that were utilized had anything to do with it. According to the aforementioned literature, empirical data indicated different degrees of a link between the two variables. The United Kingdom has been included in the panel and time-series analyses of a number of research, including those conducted by Dimitropoulos, Hunt, and Judge (no date), Adedoyin and Zakari (2020), Kirikkaleli et al. (2020), and Abbasi et al. (2020). (2021a, b). Research on the dynamic links between expanding economies and rising carbon dioxide emissions, and other variables is not being conducted in the UK. Contrary to what many people believe, it is possible to bring down CO2 emissions by putting specific economic methods into action and turning rubbish into energy that may be used.

Numerous academic studies have looked into the causes of environmental degradation by replacing the real culprit, carbon dioxide (CO2) emissions, with the surrogate, human activity. Concentrations of carbon dioxide in the air are a poor proxy for the full extent of human impact. Academics' focus has evolved in

recent years, and EP's wide scope has made it useful as an indication of environmental problems. For the first time in scholarly literature, environmental performance (EP) is being utilized as an environmental indicator after Al-Mulali and Ozturk (2015) argued that EP is a thorough enough metric to understand the ecological repercussions of human activities. In a sense, this is a breakthrough in the sector. Employing EP as the dependent variable in a panel data analysis, Al-Mulali et al. (2015) looked at the EKC in 93 different countries. The researchers concluded that EKCs are restricted to countries with a high or moderate quality of living. In addition, the study reveals that expansion of the economy helps to enhance environmental quality, despite the fact that greater consumption of energy and commercial activity both impair environmental quality. Recent results in Qatar by Charfeddine (2017) are additional proof that the EP covers a vast variety of issues.

It has been shown that Financial Development (DV), Commercial Activity, and Energy Usage all impact the economy in a positive way, and the authors of the study discover that these three elements all contribute to a U-shaped link amid GDP and Fiscal Performance.

Their investigation reveals that one of the major factors in the success to the outcomes is Exhaust gases. They looked at 15 MENA nations, much as Charfeddine and Mrabet (2017) did, to figure out what was driving the spread of the EP. The the non-oil exporting panel's connection between GDP and EP countries has the form of a U, whereas the correlation between GDP and EP in the oil-exporting nations and in the panel as a whole has the shape of an inverted U. Additionally, they found that a larger energy expenditure aided EP. In Qatar, Mrabet et al. (2017) found no correlation between GDP and EP, indicating that the two variables are not causally related. They made the observation that the price of oil had a positive influence on EP in Qatar, while trade had a negative effect on EP there. In addition, the BRICST nations do not have EKC, as stated by Dogan et al. (2020). Wang et al. (2013) found evidence to corroborate the findings of a previous study by using a global panel consisting of 150 different countries. Katircioglu et al. (2018) found that traveling to some of the most popular tourist places in the globe may lower EP while keeping EKC the same.

Hassan et al. found that in Pakistan, economic growth and EP are correlated in an inverted U-shaped fashion (2019). While Danish et al. (2020) and Ahmed and Wang (2019) established the EKC between EP and income across the BRICS countries, the link between EP and income in India was first observed by both of these research groups. Uddin et al. (2017) examined the linear association between income and EP using panel data from 27 countries. This study looked at the linear link between income and EP. It was shown that both GDP and financial growth had an impact on EP, however it was demonstrated that GDP had a greater favourable effect on EP. Globalization does make a difference EP, but commercial development does not, according to the research that was conducted by Figge et al. (2017). Because the authors feel that economic growth may capture some of the implications of globalization in other research, they suggest that it is essential to take this into consideration when investigating the Environmental Impacts of Globalization.

Rudolph and Figge (2017) found that GDP economic growth, a non-linear concept, and energy consumption all had positive effects on EP. Furthermore, all three factors were shown to be positively correlated with EP. These three factors did have a positive impact on EP, despite the fact that researchers were unable to find a connection between expansion of trade and the world economy. To the contrary, Ahmed and his colleagues discovered that globalization did not have a significant impact on EP in Malaysia (2019). It is believed that economic power (EP) may be increased via the use of money and energy, but that EP can be decreased through economic expansion and high population density. According to conclusions drawn by Solarin et al (2018) ,in the United States, economy-wide product and power consumption had a somewhat affect positively on EP. This was the case even though the effect was not significant. The BRICS nations also participated in the EKC discussion. According to Saud et al. (2020), the findings of their investigation into the effect that economic growth and globalization have had on EP in nations that are a part of the Belt and Road led them to the conclusion that these factors have a influence for the better in some of the countries has a detrimental effect in others. The researchers investigated the impact that these factors had in a number of different countries and arrived at this result. Liu et al. (2018) conducted research on Japan, China, and Korea in pursuit of inquiry the possibility of a construction amongst export diversification and the size of a country's footprint. They came to the

conclusion that the EKC takes place in Japan and Korea based on the findings of their VECM and that increased expanding the types of goods exported has led to a rise in EP. This conclusion was reached in light of the fact that they found that increased expanding the types of goods exported has led to a rise in EP. Conversely, it is crucial to point out that their study does not perform a long-term analysis; rather, it employs the VEC model and only examines the years 1990-2013. This aspect of their research should not be overlooked.

The ecological footprint of a nation is the combination of many different causes and effects, but the research that we have looked at shows that the relative significance of each cause and impact varies significantly from nation to nation (EP). Some early research has shown a positive association between GDP and EP in some nations; however, other research has failed to find any such correlation between the two variables. The growth of an economy is not only influenced by the total amount of the nation's domestic financial resources but also by the kind of those resources (EP). It is possible that it will go either way, just as the status of the ecosystems on the earth may either improve or suffer as a result of globalization. When it comes to collecting and evaluating data on the impact of various factors on the researchers' footprint, these studies usually use a symmetrical approach to data collection and analysis. We were unable to come across any research that investigated the link between these variables by using either symmetric or asymmetric ARDL approaches. Researching this connection is of the utmost importance in Japan as a result of the country's challenges, which include a growing population that places extra demands on the country's limited natural resource sources and a diminishing bio-capacity.

Research on the link between energy changes and environmental quality has taken several forms. Gencer et al. (2020) used the Sustainable Energy System Analysis Modelling Environment to conduct their research on the subject of life cycle emissions resulting from a variety of energy transitions (SESAME). They highlighted that a transformation is now taking place in the energy business by using improvements in transportation, convergence of power, inter-sectoral integration, and industrialisation. According to the findings of the experts, the increasingly complicated condition of the environment mandates a significant transformation in the manner in which we get our energy. Cardoso and González (2019) conducted

research in Argentina's dry climate to study household energy transition and thermal efficiency. The failure to make use of solutions that are efficient in terms of energy consumption results in large recurring expenditures and has ramifications for the environment. Kokkinos et al. (2020) investigated whether or not it would be possible to use Fuzzy Cognitive Map (FCM) using models to help usher in a carbon-free, sustainable future. They come to the conclusion that the availability of energy in metropolitan areas has a substantial influence on low-carbon energy transition plans and that this impact should not be ignored. Poruschi and Ambrey (2019) conducted research between the years 2001 and 2015 to investigate the effect that Australia's transition to solar photovoltaic electricity has on the built environment. They hypothesized that the use of solar panels may reduce the need for a constructed environment with a higher population density. Song and his colleagues looked at the dynamics of the Chinese government in relation to the built environment (2020). According to their results, the implementation of a low-carbon energy system might bring about unintended consequences for the natural environment.

Wang and Wang (2020) analysed 186 studies that were conducted on the subject of uncoupling the processes of growth and energy transition in command to get a deeper comprehension of the growth-energy transition nexus. The shift toward an economy with lower levels of carbon emissions has the potential to break the association that exists between nations that have both high and medium levels of wealth. A computable general equilibrium model was cast-off by Bohlmann et al. (2019) in order to examine the impact that South Africa's low-carbon energy supply has had on the expansion and the country's economy (CGE). In light of data shown above, we can infer that alterations to South Africa's energy strategy will have far-reaching consequences for the country's economic growth and for the worldwide coal market and exports. Kander and Stern (2014) investigated the relationship between the transformations of Sweden's energy system from one that relied on traditional to one that used contemporary energy sources. They asserted that contemporary forms of energy, as opposed to more conventional forms of energy, were accountable for the expansion of the economy. Tahvonen and Salo (2001) provide a comprehensive picture of the environment in which energy is created. They show that the production of energy shifts between renewable and non-renewable sources and delve into the connections between economic growth and shifts in both forms of energy. In the

article that they published in 2001, Tahvonen and Salo provide a comprehensive analysis of the current state of the energy production environment. They are examples of the transition between conventional energy production and renewable energy generating. Several studies have investigated the link between growing economies, higher rates of energy use, and worsening conditions for the natural environment.

Langnel and Amegavi (2020) investigated Ghana's energy use and ecological effect from 1971 to 2016 for their paper, which was published in 2020. Their investigation led them to the conclusion that our world is at risk when we use an excessive amount of energy. Data on Europe's energy use and its consequences on the environment were evaluated by Alola et al. (2019) for the years 1997 to 2014. They say that the solution to environmental issues brought on by non-renewable sources of electricity is to switch to renewable sources of energy. Baz et al. (2020) investigated Pakistan's ecological footprint, focusing on the variable effects of energy use from 1971 to 2014. They arrived to the conclusion that uneven energy consumption had an influence on the natural world as a consequence of their investigation, which led them to this finding. Charfeddine (2017) performed an investigation on a Markov-Switching Equilibrium Model of the connection between Qatar's energy use and its environmental effect. The results show that the environmental impact of human energy use is convex.

Another topic that is now v the academic world is the connection that growing economies have with increased use of energy. In the study by Buhari et al. (2020), the researchers looked at data on energy consumption in 32 European countries to determine how these countries' economies developed between 1995 and 2014. According to their findings, a greater use of energy is associated with a more rapid growth of the economy. A similar research examined how renewable energy affects economic development in OECD nations, and it was undertaken by Dogan et al (2020). Those with high and higher incomes have a detrimental impact on growth, while countries with lower and moderate incomes have a beneficial impact on growth. In addition, Ajmi and Inglesi-Lotz (2020) investigated how much energy is used derived from biomass was connected with the expansion of GDP in 26 OECD

nations. They provide validity to the theory that biofuels derived from biomass have the potential to stimulate economic expansion.

A growing number of experts are devoting their time and energy to examining the relationships that exist between urbanization, environmental deterioration, and economic stagnation. According to Ahmed et al finding's urbanization is beneficial to the expansion of China's economy but has long-term adverse consequences on the natural environment (2020a). Danish et al. (2020) analysed city living's consequences for the carbon footprints of the BRICS countries throughout the course of a research that spanned from 1992 to 2016. It is generally accepted that moving closer to a metropolis would result in a smaller ecological footprint for a person.

A group of researchers led by Ahmed claims that (2020b), who investigated the link between urbanization and the ecological impact of the G-7 nations, urbanization results in a greater ecological footprint. This was shown by the researchers' findings. Luo et al. conducted research to determine what effect urbanization has on the status of the environment in central China (2018). According to the findings of a research that covered the years 2005 through 2014, urbanization in central China brought to a deterioration in ecological conditions because well as an increase in the ecological pressure. Nathaniel and colleagues looked at the ways in which urbanization is affecting the environment in ASEAN nations (2020). These researchers came to the conclusion, based on their use of the Augmented Mean Group and other methodologies, that urbanization has a multiplicative impact on the adverse consequences it has on the environment (AMG).

In their study, Ali et al. (2020) looked at the topic in Nigeria between 1971 and 2014, looking at how urbanization and economic expansion are connected. The researchers believe that by testing for causality in conjunction with Maki-co-integration, they will be able to determine whether or not urbanization is the primary driver of economic development in Nigeria. In another piece of research, the researchers looked at how urbanization and economic development have evolved in China over time (Ahmed et al., 2020a) It has been determined, based on the results of this were published in Gondwana Research 103 (2022) 445-457447 and compiled by I. Khan, A. Zakari, M. Ahmad, and others, urbanization is beneficial to the development of an

economy. Liang and Yang (2019) conducted an analysis of data pertaining to 30 of China's provinces in order to identify city life, expanding economies, and more pollutants. Their investigation included the years from 2006 all the way up to 2015. Their studies have shown that investing money into a nation's physical infrastructure, academic studies, and human capital all add up to a healthy economy for that nation.

Ali et al. (2020) conducted research on Nigerian data spanning from 1971 to 2014 in order to reach findings on the connection between economic development and urbanization. Based on Maki-co-integration and causality studies, researchers in this area have come to the conclusion that urbanization in Nigeria is the key factor in the success of the country's economic growth. This conclusion was reached by the researchers. In a separate research, the authors examined how urbanization and economic development in China have changed throughout the course of the country's history (Ahmed et al., 2020a). A number of researchers, including I. Khan, A. Zakari, and M. Ahmad, as well as others, came to similar conclusions, which were detailed in Gondwana Research 103 (2022) on pages 445–457447. Liang and Yang (2019) conducted research in each of China's thirty provinces to investigate the relationships between urbanization, economic development, and pollution. Their study indicates that in order for a nation to flourish economically and make progress, it is necessary for that nation to invest money in its infrastructure, its research, and its people.

It is possible that the support provided by the banking sector for industries such as manufacturing and the building of infrastructure might assist stimulate economic growth in such regions (Baloch et al., 2019). As a result of the fact that increased economic growth leads to higher levels of energy consumption, which in turn leads to higher levels of environmental degradation, governments are frequently required to pay a price in the form of environmental degradation in order to foster increased levels of economic growth (Ahmed and Wang, 2019). However, despite the fact that a few studies have found a correlation between increasing levels of wealth and deteriorating environmental conditions, there is reason for optimism on the basis of green technology, maximized power savings, stricter environmental regulations, and innovative approaches. As a consequence of this, the EKC hypothesis is often used in academic inquiry on the connection between prosperity and the health of ecosystems. There has been a U-shaped correlation, an inverted U-shaped link, and no link at all

between economic expansion and inflation throughout the years (Al-Mulali et al., 2015; Charfeddine, 2017). Also, there is absolutely no connection between the two (Al-Mulali et al., 2015). To wit: (Wang et al., 2013).

According to Saud et al., there is mounting evidence that globalization and the expansion of the financial sector are having both positive and harmful consequences on the natural environment. [Citation needed] (2020). (DV). The most significant flaw in past studies was that they improperly gauged level of environmental damage based on the amount of carbon dioxide emissions. That was a significant cause for concern. Environmental performance (EP), as proposed by the most precise and all-encompassing indicator of environmental degradation is Dogan et al. (2020). This is according to the researchers. It's no secret that there's been a rise in academic interest in EP; nevertheless, a critical restriction is that the majority of these research' analyses of EP drivers have relied on symmetric methodologies. [Case in point:] [Case in point:] [Case in point:] It is possible for macroeconomic variables to have asymmetric properties as a result of their exposure to external factors such as international commerce, business cycles, and the supply and demand for commodities produced both locally and internationally (Rehman et al., 2020).

As a consequence of this, it is a reasonable assumption to make that variations in these parameters, whether they be good or negative, may have varied degrees of influence. That variation As a consequence of this fact, there might be inconsistencies in the globalization of financial markets and the economy as a whole. It is reasonable to anticipate and does not rule out the possibility of an asymmetrical distribution of the consequences that these developments will have. For instance, study carried out by Koengkan et al. (2020) revealed that the influences of globalization on emissions were found to be rather uneven. This study employs symmetric and asymmetric research methods to investigate the effects of globalization (G) and financial development (DV) on economic performance. The letter G stands for "globalization" in this acronym, whereas the letter DV stands for "development" (EP). The reason for this is because the majority of performed research up to this point have used asymmetrical methodologies, which has resulted in inconsistent findings about the influence of these repressors on EP's environment. The EKC hypothesis (which analyses the association between footprint and income)

will be tested over the whole of the study in a number of different methods. This will be done so in order to ensure that the hypothesis is accurate.

CHARPTER III

Study Methodology

Introduction

In this section of the research, an in-depth debate is held on the many strategies, procedures, and methods that were used in demand to collect the necessary data for the revision. In this unit, we will also review the data assessment processes used throughout the research and look at the consequences of using those procedures. These approaches were used to do an analysis on the information that was congregated over the sequence of the investigation.

Data and Data Sources

The information that was used in this investigation was found by searching through the World Development Indicators database, which is available online and can be accessed by anyone. This information was applied to either the independent or the dependent variable, depending on which one it applied to. Only a small proportion of the variables were presented in ways that prevented them from being utilized in any way so that the study's goals may be met. The remaining variables were discussed in terms of the applications that could be made of them in order to accomplish the objectives of the thesis. Our study's dependent variable is a of the sub-Saharan African region's health conditions and capacity for long-term economic growth, we used the region's environmental air pollution levels. In addition, we took into account financial development, consumption of renewable energy, and environmentally responsible growth. During the course of the investigation, we looked into the following aspects:

Environmental Air Pollution (EAP) - No matter whether it is chemical, physical, or biological in origin, if a material has the ability to change the environment of the atmosphere, then that substance has the potential to be a cause of air pollution. The quality of the air both inside and outside a building may suffer as a direct result of pollution. Stoves, vehicles, industries, and even campfires may all be considered sources of considerable air pollution because of the combustion products they

produce. There is some evidence to suggest that particles, carbon monoxide, ozone, nitrogen dioxide, and sulfur dioxide are all examples of pollutants. may be detrimental to people's health. Disease, premature death, and disability are all on the increase around the globe, and one of the primary contributors to this trend is air pollution. According to the data compiled according to the WHO (World Health Organization)), almost all People all throughout the globe make up the vast majority of the planet's total population. is exposed to air that contains unhealthy levels of pollution. Countries with low and moderate incomes are more susceptible to the negative effects that effluence may have.

The condition of the atmosphere that surrounds the globe has a noteworthy impression on both the climate and the ecosystems that live on it. Changes in the climate may be attributed in part to the combustion of fossil fuels, many factors that contribute to air pollution, which in turn is one of the many factors that also contribute to the generation of gases that contribute to global warming. Air pollution is generated by a wide variety of factors. As a result, actions taken to reduce levels of air pollution provide a solution that is beneficial to both human health and the health of the planet. These measures will, over the course of time, reduce the pace of climate change while simultaneously lowering the number of deaths and diseases that are attributable to air pollution.

Green growth (GG) - The process of supporting economic growth and development while also safeguarding and maintaining the natural capital that supplies essential resources and ecosystem services for human life is referred to as "green growth." Green growth is also often referred to as "sustainable growth." In order to accomplish this goal, it is necessary to support investment and innovation, which, in turn, will foster economic growth over the lengthy period and the advent of new opportunities for businesses. The term "green growth" and sustainable development are not interchangeable terms. Instead, it offers a versatile and workable strategy for greening economic growth that takes into account the social implications of societal changes brought about by economic shifts. In other words, it intends to act as a catalyst for the transition toward types the expansion of the economy that are less damaging to the ecosystem. Green growth plans have as their primary objective the maximization, in a manner that is both viable in terms of the environment and

society, of the economic potential of natural assets. Examples of this potential being put to use include the accessibility of air and water, as well as the resiliency of biodiversity, which is essential for both the production of food and the maintenance of human health. Green growth techniques acknowledge the finite character of the Earth's natural resources and seek to slow or stop their depletion. Green growth is also known as sustainable development. In May of 2011, the OECD's Green Growth Strategy was presented to more than forty heads of state and ministers from member states. These individuals had a favorable opinion of the approach because it represented a tool that could be used to increase economic development and the formation of trades through the conservation of natural assets, the optimization of energy usage, and the assessment of the worth of ecosystem services. These are all things that can be accomplished by determining the value of ecosystem services. They praised the plan for its potential to cut emissions of greenhouse gases and boost the value of ecosystem services as an additional benefit. In other words, the strategy was a winner all around. The adoption of this strategy was a request made by the Green Growth Declaration's signatory ministers from the 34 nations in 2009. In 2009, these countries signed the Declaration, making a commitment to boost their pursuit of green development choices as a response to the economic crisis and other factors beyond their control. This promise served as the impetus for the request for the plan.

Renewable Energy Consumption (REC) - How much energy a nation gets from renewable sources is defined by contrasting it with its total gross inland consumption of energy from primary sources? This percentage is calculated on the last day of each year, on December 31. To easily raise the quantity of renewable energy that is used in the United States, all that would be required is an increase in the overall amount of energy production. Examples of renewable energy include biomass power, hydropower, wave power, tidal power, and gas from landfills and sewage treatment facilities. Other forms of renewable energy include wave power and tidal power. Geothermal energy, wave power, and tidal power are three more forms of renewable energy that may be harnessed for power production. The term "renewable energy" refers to any kind of electricity that does not originate from a resource that cannot be replenished, such as fossil fuels. The ambit of this is broad enough to take into account any and all possible sources of authority. Definition: Energy that originates

from non-delectable sources and can be replenished at a rate that is greater than the rate at which it is used is referred to as renewable energy. Alternative forms of energy, such as wind and solar power, could be able to restore depleted supplies. There are many different kinds of renewable energy sources, and it is not difficult to learn about them or get access to them. However, nonrenewable resources are not capable of being renewed, and it may take millions or even billions of years before anything new can be produced using these resources. When fossil fuels are used to produce energy, they give off toxic pollutants and greenhouse gases like carbon dioxide, which are then released into the atmosphere. It's possible that more toxins will be released into the atmosphere. The process of transforming solar and wind energy into usable electricity at renewable energy facilities results in much fewer emissions of greenhouse gases than that of conventional power plants that make electricity by burning fossil fuels. If we want to find a way out of the climate catastrophe, the usage of fossil fuels, which are the principal source of greenhouse gas emissions today, must be reduced or eliminated entirely. This transition has to happen at the same time that renewable energy options are being developed.

However, although there are now three times as many people employed in the renewable energy sector as there are in the fossil fuel sector, the price of renewable energy is higher in most nations.

Financial Development (FD) - The "institutions," "instruments," and "markets" of the economy, as well as the "legal and regulatory framework" that controls those entities, are all included in what is referred to as the "financial sector." These components make it possible to "transact by awarding credit," as the phrase puts it. This idea is taken directly from the theoretical framework of economics. The growth of the financial industry as a whole works toward the overarching goal of reducing the "costs" of the system by any and all ways available. Because of this, we now have financial contracts, markets, and intermediaries, all of which have aided in lowering the expenses connected with activities such as information collecting, the enforcement of contracts, and the processing of transactions. The current financial system is the product of an intricate web of interconnections that has developed over the course of history. This web is responsible for the existence of all of the contracts, markets, and intermediaries that make up the current system. This is due, in part, to

disparities across countries in the costs of information and transactions, as well as variances in legal, regulatory, and tax systems. A well-designed and effective monetary system has to be able to fulfill the following five major functions: I the generation of information in advance about potential capital allocation and investment; (ii) related to the availability of financing, the monitoring of investments and the practice of corporate governance; (iii) advocacy for hedging strategies and diversification; (iv) capitalization and pooling of resources; and (v) encouragement of commercial activity. Therefore, advancement in the monetary area occurs when monetary systems, exchanges, and middlemen increase the supply of the critical tasks that the financial sector performs for the economy while simultaneously reducing the negative consequences of information, enforcement, and transaction costs. This is the definition of progress. When there is development being achieved, this is something that will always be the case.

Model specification

"Model specification" refers to the process of selecting the variables that will be used in a given model (MacCallum 1995). It may be advantageous to add all relevant variables to the model specification; however, doing so may cause a reduction in the statistical power of the model. As a result, in order to explore the links between environmental air pollution, green growth in consumption of renewable energy, and financial development in sub-Saharan Africa, we design the following econometric model formulation.

$$EAP_{qk} = f\left(GGI_{qk}, REC_{qk}, FDI_{qk}\right)$$

(1)

Indicators of favorable environmental outcomes include green growth (GG), renewable energy consumption (REC), foreign direct investment (FDI), and random errorμ, whereas environmental air pollution (EAP) acts as a proxy for environmental degradation. We get the following result when we log-linearize the model so that it can be used in empirical research:

$$EAP_{qk} = \beta_0 + \beta_1 GGI_{qk} + \beta_2 lnREC_{qk} + \beta_3 lnFDI_{qk} + \mu_{qk}$$

(2)

Where β_0 and $\beta_{1\text{-}3}$ is the variable's intercept, while the other numbers are the coefficients and q indicates the nation and k represent time era.

Model Estimation Strategy

Correlation Matrix Test

Using the Correlation Matrix, one is able to construct inferential statistics on an explanation of the relationship between the various study factors. Two of the most important aspects of factor analysis are the KMO and Bartlett's Test of sphericity. It is a method for ensuring that sufficient samples have been collected. The Kaiser-Meyer-Olkin (KMO) and Bartlett formulas were used to create the correlation matrices that are shown in Table 5.2. The KMO sample adequacy test examines the data set in the issue to assess whether or not factor analysis is an appropriate method to use. The value of KMO might fall anywhere between 0 and 1, with a value near 0 suggesting that the overall number of partial correlations is very high in contrast to the total number of correlations. On the other hand, Bartlett's test of sphericity is used Therefore, it is necessary to test the hypotheses to see whether the variables included within the population correlation matrix are, in fact, uncorrelated. However, it is possible that there are some variables that don't correlate very strongly with other variables, even if Bartlett's test reveals that the correlation matrix isn't roughly an identity matrix. This is especially likely when there are a large number of variables and a large sample to consider.

Panel Unit Root Test

We used the panel unit root test so that we could choose which econometric model would be of the most assistance to our empirical research. As a consequence of this, we were successful in locating the longitudinal as well as the cross-sectional dependent variables. The project was finished up before any decision was made on

an economic model. In addition to that, we made use of the Panel Unit Root Test that had been created by I'm, Pesaran, and Shin, in addition to the Cross-Sectional Augmented Dickey-Fuller Test that had been developed by Pesaran. Pesaran is responsible for the development of both of these tests. In every instance, the outcomes were described as "perfect" (2004, 2007). The CIPS and CADF tests cannot be successful without taking into account the cross-sectional dependence. The purpose of the experiment is to evaluate the alternative hypothesis in comparison to the null hypothesis of the unit root. Each variable is non-stationary at this point, but it has the potential to become stationary once its significance at the first level is determined. In light of the evidence presented, it is plausible to draw the conclusion that the elements at play in the case are considerably co-integrated throughout the course of time. Given that the sample data include cross-sectional dependencies, first-generation panel unit root testing should be avoided. This is because of the presence of the dependencies. This research used the second-generation unit root test because Pesaran hypothesized that there was a cross-sectional dependence between the variables (2007). It is common practice to write the equation with ε_t serving as the independent variable as follows:

$$e_{\theta t} = (1 - e_\theta)\varepsilon_\theta + \varepsilon_\theta e_{\theta,t-1} + \varepsilon_{\theta t,} t = 1, \ldots\ldots, M_{;}\ t = 1, \ldots\ldots, K$$

(3)

Where '$\varepsilon_{\theta t}$' represents the error term, which can be written as the f_t function of the hidden common factor.

$$\varepsilon_{\theta t} = K_\theta f_t + \mu_{\theta t}$$

(4)

As $\varepsilon_{\theta t}$ represents a country-specific factor, thus, we obtain Equation 5 below from Equation (3).

$$\Delta e_{\theta t} = \beta_\theta + \delta_\theta e_{\theta,t-1} + k_\theta f_t + \mu_{\theta t}$$

(5)

as a result, we use a test called the CADF panel unit root test to examine whether or not there is a trend in the data.

$$\Delta e_{\theta t} = \beta_\theta + \delta_\theta e_{\theta,t-1} + d_\theta \Delta \bar{e}_t + \mu_{\theta t}$$

(6)

The null hypothesis of no stationary associated with each series in equation (6) determines the integration order based on the OLS estimator δ_θ. The following equation (7) represents the CADF t statistical mathematical expression

$$t_t(K,T) = \frac{\Delta \acute{y}_\theta \bar{M}_{w\, z\theta-1}}{\hat{\pi}_\theta(\acute{y}_\theta \bar{M}_{w^z\theta-1})}$$

(7)

Critical values and simulations are needed for the following CIPS tests that are derived from the preceding general equation (7).

$$CIPS(K,T) = \bar{t} = K^{-1} \sum_{\theta=1}^{K} t_\theta(K,T)$$

(8)

Panel Co-Integration Tests

Granger's causality analysis, as defined by Westerlund, contends that testing for the presence of variable co-integration necessitates determining whether or not the variables in question are stationary in relation to one another. Westerlund's explanation of this analysis can be found here (2007). Westerlund (2007) advises taking the position that there is no co-integration as part of the panel co-integration test. This is referred to as the null hypothesis. As a result, the Westerlund panel co-integration test does not limit itself to the presence or absence of a common component; rather, it assumes the presence of error correction for both individual panel members (Gt & Ga) as well as the panel as a whole. This is because the test was developed by Westerlund. The effectiveness of the test may be attributed to the fact that it takes into account the possibility that there may be other signs of the existence of a common component besides the presence or absence of the component itself (Pt & Pa). The approach is distinguished from others in that it focuses on structure rather than residual dynamics and is resistant to the effect of confounding circumstances. These are two of the method's distinguishing characteristics (Zhang et al., 2022; Ibrahim et al., 2022). The econometric model that was used in Westerlund's co-integration test may be seen below in the form of an equation (2007).

$$\Delta Y_{\theta t} = \vartheta_\theta d_t + \beta_\theta Y_{\theta t-1} + \acute{\delta}_\theta Z_{\theta t-1} + \sum_{p=1}^{K\theta} \beta_{\theta p} \Delta u_{\theta t-p} + \sum_{p=1}^{K\theta} \delta_{\theta t} \Delta x_{\theta t-p} + \mu_{\theta t} \qquad (9)$$

In equation (9), above, β_θ is the adjustment speed that determines how quickly the long-term fluctuation corrects itself following the short-term imbalance? Two of Westerlund's (2007) four tests for co-integration are highlighted here; these are the group mean statistics.

$$G_t = \frac{1}{N}\sum_{\theta=1}^{N}\frac{\widetilde{\gamma_\theta}}{SE(\gamma_\theta)}$$

(10)

$$G_\alpha = \frac{1}{N}\sum_{\theta=1}^{N}\frac{T\widetilde{\gamma}_\theta}{\gamma_\theta(1)}$$

(11)

The null hypo lag-independent is no co-integration relationship between the variables in the full panel can be rejected if the two tests are found to be statistically significant. Co-integration in at least one country is investigated based on data from the fixed two panels.

$$P_t = \frac{\widetilde{\gamma}_\theta}{SE(\widetilde{\gamma}_\theta)}$$

(12)

$$P_\alpha = T\breve{\gamma}_\theta$$

(13)

Models Estimators Techniques

The maximum likelihood estimate (MLE) was utilized, and Pesaran et an l" Mean's Group (MG)," "Pooled Mean Group (PMG)," and "Dynamic Fixed Effect (DFE)" were the groups that were established (Pesaran et al. 1999). In this section, we will discuss the PMG model, which is an error correction model that places panel regression in that category**.**

$$EAP_{\theta=}\beta_i + \sum_{t-1}^{k1}\gamma_{qt}\ GG_{Index\ qt-k} + \sum_{t-1}^{k2}\delta_{qt}\,REC_{Index\ qt-k} + \sum_{t-0}^{p}\vartheta^{f}{}_{qt}\,FD_{Index\ qt-k} + \varepsilon_{qt} \qquad (14)$$

Where N is an integer in the positive that represents the total number of countries that were considered. We use the notation t=1, 2, 3, 4..., t to represent the passing of a year. The notation [t] is used to indicate the lag times. The lag-dependent variable

is represented by the letter [k], whereas the lag-independent variables are represented by the letter [p]. Environment Air Pollution (EAP), Green Growth Index (GG Index), Renewable Energy Consumption Index (REC Index), Financial Development Index (FD Index), and an error term having a "fixed effect" on the other variables are the variables that are being analysed. In order to reorganize equation (2), Pesaran, Shin, and Smith (Pesaran et al., 1999) rewrote it as follows:

$$EAP_{\theta} = \beta_i + \sigma EAP_{2qk-1} + \delta_i' X_{qk-1} + \sum_{t-1}^{k-1} \pi_{\theta} \Delta EAP_{2qk-t} + \sum_{t-0}^{q-1} \Delta X_{qk-t} \quad (15)$$

Where $\pi = -1\left[1 - \sum_{t=1}^{q} \pi_{qk}\right], \beta_i = \sum_{t=0}^{q} \gamma_{qk}, \ \pi_{qk} = -\sum_{m=t+1}^{q} \pi_{m\theta,}$

t = 1,2, ……..., q – 1, and $\delta_{\theta} = -\sum_{m=t+1}^{q} \pi_{m\theta,}$ t = 1, 2, ……, k – 1,

Parameters classifying the levels are used to adjust Equation 5 according to the error correction formula.

$$EAP_{\theta} = \beta_i + \sigma_i\left\{\Delta EAP_{qk-1} - \delta_i' X_{qk-1}\right\} + \sum_{t=1}^{q-1} \pi_{qk} \Delta EAP_{2qk-t} + \sum_{t=0}^{k-1} \delta_{qk}^{*} \Delta X_{qk-t} + \varepsilon_{qk} \quad (16)$$

Long-term equilibrium between $[\Delta EAP_{\theta t}]$ and $[X_{\theta t}]$ is $[\delta_i = (\beta_i/\varphi_i)]$. Modified growth dynamics, such as changes in $[X_{\theta t}]$, are represented by $\left[\vartheta_{qt*} \ and \ \delta_{qt}^{*\prime}\right]$, respectively, and are related to the short-run coefcient's historical values. Last but not least, the (μ_t) error adjustment coefficient measures how quickly $[LCO_{2it}]$ returns to symmetry after an adjustment to $[X_{\theta t}]$. To establish a long-term connection ($\varphi_t > 0$), to be valid, the coefficient or factor must be both statistically substantial and destructive. When $[\varphi_t]$ very negative, integration is supported. Consequently, we can derive the following estimates:

$$\delta_{PMG} = \frac{\sum_{i=1}^{N} \delta_i}{N}, \beta_{tPMG} = \frac{\sum_{i=1}^{N} \beta_i}{N}; \ \varphi_{tPMG} = \frac{\sum_{i=1}^{N} \varphi_i}{N}, and \ \vartheta_{tPMG} = \frac{\sum_{i=1}^{N} \vartheta_i}{N} \quad (17)$$

Where t = 0… q – 1,$\delta_{PMG} = \delta$. Based on the method presented in Equation 5, the following model is derived:

$$\Delta EAP_{k-t} = \gamma_k + \sigma_k\big(\Delta EAP_{k,t-1} - \beta_1 GG_{Index\,k,t-1} - \beta_2 REC_{k,t-1} - \beta_3 FD_{Index\,k,t-1}\big) + \sum_{t-1}^{q-1} \vartheta_t^k \Delta(\Delta EAP_{kt}) + \sum_{t=0}^{q-1} \mu_{1t}^k \Delta(GG_{Index\,t}) + \sum_{t=0}^{q-1} \mu_{2t}^k \Delta(REC_{kt}) + \sum_{t=0}^{q-1} \mu_{3t}^k \Delta(FD_{Index\,kt}) + \mu_{k,te}$$

(18)

The PMG approach takes into consideration both short-term and long-term swings in its calculations, but it normally gives more weight to the longer-term variations. An estimate using the panel ARDL approach is shown in the following (the "MG estimator"). Utilizing this calculator to do research on a more regional basis is a great idea. On the other hand, the PMG approach calls on its contributors to exhibit both permanent and transitory varieties of diversity. The length of the series was used as the basis for the calculation that determined the "estimator's" dependability and consistency. The "DFE estimator" is a helpful instrument that serves as the concluding step of an estimation process that is also known as the "ARDL technique." The DFE approach is predicated, both immediately and in the long term, on the homogeneity constraints of the data.

Panel Causality Test

The panel ARDL coefficients are able to provide valuable insights; nevertheless, they do not demonstrate the causal relationship between the indicators that are being investigated. In order for policymakers to establish policies that are effective, they require additional information on the causal connection. The "Granger Casualty test" was developed by Dumitrescu and Hurlin (2012) with the purpose of determining whether or not there was a connection between the series. The test is able to differentiate between "heterogeneous and unbalanced panels" in situations in which "T > N or T N." (Dumitrescu and Hurlin 2012). In order to demonstrate how reliable, the statistics are in models employing tiny datasets, Monte Carlo simulation is utilized. In this study, we concentrated on something called the "heterogeneous linear model."

$$\gamma_{ij} = \emptyset_i + \sum_{i=1}^{L} \partial_i^k \gamma_{i,t-k} + \sum_{i=1}^{L} M_i^{(L)} X_{i,t-k} + \varepsilon_{i,t}$$

(19)

Where L, $\varepsilon, N^{+}$is a constant term, L, $\varepsilon, N^{*}$is the constant (parameter) of lag, and $M_i = (M_i^1, \ldots \ldots M_i^L)$, $\emptyset_{i,} \partial_i^L \, and \, M_i^L$ displays the slope of the coefficient. Assumption of nothing (H_0) All the non-homogeneous variables were evaluated based on the lack of Granger causality, whereas the null hypothesis was that there was such a lack (H_1) The foundation of the evaluation is the presence of Granger causality between the panel's observed variables. Underneath is H_0 and H_1:

$H_0 = M_i = 0$ $H_1=1$

CHARPTER IV

Findings and Discussions

Correlation Matrix

Using the Correlation Matrix, one is able to construct inferential statistics on the connection between all of the many aspects of the research. Two of the most important aspects of factor analysis are called the KMO and the Bartlett's Test of sphericity, respectively. It is a method for determining whether or not sufficient samples were collected. Both the Kaiser-Meyer-Olkin (KMO) and Bartlett processes were used in order to arrive at the results that are shown in Table 5.2 as correlation matrices. The KMO sample adequacy test might be of assistance to you if you are unsure as to whether or not factor analysis is the appropriate method to use for your data. A number closer to 0 for KMO indicates that the total sum of partial correlations is high in comparison to the overall sum of correlations. The range of possible values for KMO is from 0 to 1, with a value closer to 0 suggesting that this is the case. However, Bartlett's test of sphericity may be used to examine whether or not the alternative hypothesis—that there is a correlation between the variables in the population correlation matrix—is true. Even if Bartlett's test indicates that the correlation matrix isn't nearly an identity matrix, it is still possible that certain variables don't correlate very strongly with other variables. This is especially true when there is a large number of variables and a large sample size. A KMO test result indicator value of 0.789, which is near 1, proves that the variables work well with factor analysis and have a high degree of correlation. This information is derived from Table 2. On the other hand, the study reveals that there is a sizeable disparity between the correlation matrices, which is supported by the fact that the result of 566.335 for the Bartlett Chi-square test for the difference is statistically significant (p-value< $\alpha = .001$).

Table 1.1 Presents Summary of KMO & Bartlett's Test Outcomes

Component	Eigenvalue	Difference	Proportion	Cumulative
BITM	2.280	0.974	0.456	0.456
BROA	1.305	0.198	0.261	0.717
BROE	1.107	0.889	0.221	0.938
BOTA	0.217	0.129	0.043	0.982
BNITI	0.088	-	0.017	1.000
Correlation Matrix	0.064		Degree of freedom	10
Bartlett test	Chi-square P(V)	566.335 0.000		
KMO	P(V)	0.789		

Note: BITM: Business Information Technology Management; BROA: ***Biodiversity Risk Opportunity Assessment;*** BROE: BNITI, KMO. Source: Author's computation

Unit Root Tests Outcomes

The empirical findings shown in Table 2 demonstrate that there is a robust connection between the variables, and factor analysis seems to be a suitable method of investigation given the KMO test results indicator value of 0.789. The findings of this investigation provide evidence against the hypothesis that each nation in Sub-Saharan Africa is operating at the same level of development and technological advancement. This is supported by the observation that there is a sizeable disparity between the correlation matrices that all of the models used, which assumed that slope heterogeneity effects would be present. The next thing we will do in the analysis is to see whether any of the variables have changed from earlier in the process (stationary test). As a consequence of this, we conducted the unit-root tests for our panel using a robust stationary version of the cross-sectional Pesaran and Shin (CIPS) test as well as an augmented Dickey-Fuller (ADF) test (Pesaran, 2007). It has been shown that the CADF and CIPS unit root tests perform much better than

the PP test and the KPSS stationarity test when used to panel data that is accompanied by a heterogeneity model with autoregressive coefficients.

In addition to this, it has good control over the interdependence between cross-sections. Taking into account both of the arguments, it has been shown via experimentation that the CIPS and CADF unit-root tests function successfully when applied to panel datasets. After applying the first difference with constant and trend to the estimated model, the variables were able to become stationary at the I (1) level with a 5% level of significance. This was the case despite the fact that all variables for the CIPS and CADF unit-root tests were not stationary at levels [I (0)]. In light of these results, it follows that variables such as GGI, EAP, REC, and FID in Sub-Saharan countries display comparable patterns of stationary order of I (1) when taking CADF unit root tests into consideration, as is shown in Table 2.

Table 2.1 Unit Root Test Results

Variables	**CIPS**		C**ADF**	
	Level	**First Difference**	**Level**	**First Difference**
GGI	-2.713 **	-3.146 **	-4.011	-4.735**
EAP	-0.527	-3.734 **	4.730	-6.648**
REC	-1.755	-3.734 **	-0.178	-3.217**
FID	-2.502**	-2.679 **	-3.166	-5.601**

Note: *, ** and *** signify1%, 5% and 10% levels of significance. **Source: Author's computation**

Panel Co-Integration Tests Outcomes

In addition, the co-integration approach may be used when the static characteristics of the Pesaran CIPS and CADF unit-root tests have been determined. This is the case when it is possible to apply the strategy. As a significance of the findings of the Pesaran CIPS unit root test, it is abundantly clear that all of these variables are integrated at the first difference, with the exception of GGI and FID, which became stationary at level; consequently, OLS cannot be used to validate the

co-integration among these variables. In order to accomplish this goal, the co-integration approach provided by Westerlund (2012) was used. Table 3 displays the findings obtained from a co-integration test that was conducted by Westerlund (2012). The co-integration test that is provided in Wasteland (2012) is a dependable way for rectifying errors that have been made in the past (ECM). Statistical estimators other than goodness of fit are used, and the Schwarz Bayesian Information Criterion (SIC) or the Akaike Information Criterion (AIC) are utilized to estimate the lag duration in the variables. Using the AIC criterion, the model that provides the greatest fit, despite having a limited intercept and no trend, is selected (Kirikkaleli et al., 2021). The Z-value that was computed using Wasteland (2012) is compared in Table 3 with the critical value that was discovered inside a specific group. This table represents the Gt and Ga models generally, while also exhibiting the Pt and Pa models. Even if serial correlation, heterogeneity, and cross-section dependence are all present, Ga (-0.8330, P< 0.001) and Pa (-0.5550, p< 0.710) suggest that the lack of co-integration is not supported by the data. This is the case despite the fact that serial correlation is present. In a nutshell, this demonstrates that the variables that were computed are a part of a dynamic co-integration equilibrium connection that exists both in the long run and the short run. In addition, the estimated value of the lagged error correction term (ECM) coefficient in our model is as follows: $\frac{\text{Pa}}{T} = \frac{-5.550}{11} =$ -0.5045. According to Table 3, the estimated variables in the countries of Sub-Saharan Africa have a long-run co-integration relationship that hints to a yearly adjustment to short-run disequilibrium of 50.45%. This is suggested by the relationship's existence.

Table 3.1 Summary of Wasteland panel co-integration results

Statistic	Value	Z-Value	P-Value
Gt	-3.083	-6.333	0.000 *
Ga	-0.833	-5.052	0.000
Pt	-8.520	-2.223	0.013 *
Pa	-3.665	-0.555	0.710
Note: ** and * signify 0.01 and 0.05 levels of significance, correspondingly			

Source: Author's computation

Taking into account both of the arguments, it has been shown via experimentation that the CIPS and CADF unit-root tests function successfully when applied to panel datasets. Throughout the course of this investigation, we make use of the Mean Group (GM), Pooled Mean Group (PMG), and Dynamic Fixed Effect (DFE) estimations in order to take into account the inconsistencies in the parameters and the biased characteristics of the variables that we estimate.

Models Estimators Test Outcomes

After confirming the sequence's co-integration, the author used the Pooled Mean Group (PMG) estimator to assess the short/long run association between Environmental Air Pollution (EAP), Green Growth (GG), Renewable Energy Consumption (REC), and Financial Development (FD). Table 6 shows what we learn from the PMG, MG, and DFE estimations of the P-ARDL. According to the findings of the Hausman specification test, PMG estimation is the best technique to pool the long-run coefficients, thus this is the method that should be used to estimate the coefficients; the "homogenous constraint" in the "long-term balance" is important. The findings show that green growth has a negative impact on environmental air pollution in both the short and long runs, with a 1% increase in green growth decreasing environmental air pollution by 0.4340% and 2.466% in the short and long runs, respectively. Another study backs up this result (Sowah & Kirikkaleli, 2022). Green growth is critical to the implementation of proper and smart environmental regulations. In this context, the importance of green growth in promoting economic growth and development while ensuring that natural assets continue to supply the resources and environmental services on which our well-being is dependent, as demonstrated by regulatory implementation. The development of the economy that is done in an environmentally friendly manner is sometimes referred to as "green growth." To put it another way, as long as boosting economic production continues to be the primary objective, the expansion of the economy must be decoupled from the growing use of limited resources and the negative impact it has on the natural world. Therefore, the concepts of low-carbon or sustainable development as well as the green economy are linked to the concept of

green growth. Making the switch to renewable energy sources is a crucial component of environmentally conscious growth. Employment opportunities, according to proponents of "green growth," in sustainable forestry, environmentally friendly agriculture, and renewable energy. If the appropriate policies are put into place, the shift to a greener economy might result in the creation of 24 million new employment throughout the globe by the year 2030. Tobias (2017). (2017). In addition, there is a possibility that 72 million full-time jobs could be lost due to heat stress by the year 2030, and if temperatures continue to rise, there will be less available work hours, particularly in agriculture. This will occur if there is not a transition to a green economy (UN labour agency, 2018). Despite some empirical criticism (Mertens et al., 2021; Griffith-Jones & Ocampo, 2018), the author of this thesis believes that investing in green growth technologies can help millions more people overcome poverty, provide better livelihoods, and have a positive impact on environmental quality in Sub-Saharan African countries.

In addition, According to PMG's estimation, using renewable energy sources for an extended period of time increases environmental air pollution, with a 1% increase in renewable energy consumption resulting in a 1.0990% decrease in environmental air pollution. This observation corroborated the results of Liu et al. (2023) and Kirikkaleli and Adebayo (2020). Energy that is generated from renewable sources is replenished at a quicker pace than it is used up. Such sources are abundant in nature, such as sunlight and wind. There are many of renewable energy options available. Most nations have seen a decrease in the cost of renewable energy, and they provide three times as many employment as fossil fuels. Burning fossil fuels for electricity generation releases greenhouse gases like carbon dioxide into the atmosphere. If we want to solve the problem of air pollution in the long run, we need to switch from fossil fuels, which are responsible for the vast bulk of emissions, to renewable energy. At the same 1% short-term variation, PMG estimates for renewable energy use increase environmental air pollution by 0.6090%. Less fortunate people in the rural parts of Sub-Saharan African nations rely on renewable energy sources like biomass for daily needs like cooking, lighting, and warmth. Greenhouse gases are released as a by-product of biomass power generation. Because of the potential for deforestation, land-use change, and environmental air pollution brought on by

massive expansions of forest and bioenergy plantations, their usage should be strictly regulated.

Furthermore, the results of the P-ARDL estimations from the PMG for financial development have a short-term relationship with environmental air pollution. In the short-long run, a 1% change in financial development reduces relation environmental air pollution by 0.2830% and 3.9510%. Other research by Mia et al. (2022) and Adebayo (2022) support this (2022). The development of an economy's financial sector comprises of those entities that specialize in the purchasing and selling of financial claims. As a consequence of this, advancements are made in the financial sector when financial instruments, markets, and intermediaries enhance the effectiveness with which the sector carries out its fundamental responsibilities by lowering the adverse effects of information, transaction, and enforcement costs. It is possible to alleviate poverty and inequality through increasing investment and productivity, as well as improving risk management, increasing access to capital, and improving risk management. Therefore investment in fossil fuel resources increases environmental air pollution in Sub-Saharan Africa. These findings imply that financial sector development alone will not response to the unruly of environmental air pollution; further essentials are required; and increased technological progress that facilitates and encourages foreign capital inflows into investments in green technologies may eventually lead to a reduction in environmental air pollution.

This research comes to the conclusion, based on these observations that the success of Sub-Saharan African nations in reducing environmental air pollution depends on promoting green growth, increasing the use of renewable energy sources, and improving the economic infrastructure of the region. This is true for both the short-term and long-term success of these nations. Table 4 demonstrates that the ECT (Error Correction Term) statistical value of MG (-0.5540), PMG (-0.2120), and DFE (-0.7980) confirm that green growth, renewable energy consumption, and financial development have an equilibrium long-run co-integration relationship as a result of the datasets covering Sub-Saharan African countries. This is shown by the negative values for MG and PMG, respectively. The constant result is negative in the PMG model, and the reason is that all the selected variables in this equation are associated with a negative relationship with environmental pollution. These results are

consistent with a number of studies, including those by Aliya et al. (2022), Assi et al. (2021), Mustafa Naimoglu (2022), Reza Tajaddini et al. (2021), and D. O. Olayungbo et al. (2019), demonstrate that the constant of the study has a negative value and is therefore considered to be absolute when the PMG-ARDL model is utilized. This conclusion was reached by these researchers.

Table 4.1 Summary of GM, PGM, and DFE Models Test Results

Table 4 summary of GM, PGM, and DFE Models Test Results						
Variable	MG		PMG		DFE	
	Long term	Sort Run	Long term	Short term	Long term	Sort term
ECT	-0.5540 [0.016]*		-0.2120 [0.021]*		-0.7980 [0.000]*	
GGI_{L1}	-2.8490 [0.214]		-2.4650 [0.000]*		-0.8910 [0.004]*	
REC_{L1}	3.1950 [0.279]		-1.0990 [0.000]*		-0.083 [0.619]	
FDI	-2.4170 [0.408]		-3.9510 [0.000]*		-0.8070 [0.037]*	
ΔGGI		-4.7470 [0.050]*		-0.4340 [0.755]		-0.5390 [0.144]
ΔREC		0.2870 [0.521]		0.6090 [0.117]		0.2150 [0.153]
ΔFDI		-1.5890 [0.300]		-0.2830 [0.557]		0.0300 [0.912]
Con.	177.09 [0.091]*		-40.543 [0.040]*		67.5280 [0.000]*	
Hausman	0.110 [0.990]			3.0800 [0.037]		
Obs/Group	190/19		190/19		190/19	
Notes: ECT: Error Correction Term; *, Denote statistical significance at, 5%. The value of the coefficient is out of brackets.						

Panel Causality Test Outcomes

Table 5 provides a summary of the findings from the causality test conducted by Dumitrescu and Hurlin. (2012). In light of the information presented above, it is conceivable that we may utilize the findings of the causality test to develop effective policies that would improve the standard of living in the countries of sub-Saharan Africa. An estimate for the causality test that had been produced by Dumitrescu-Hurlin was used in this particular investigation (2012). The causality test estimator was employed in the same manner that the more conventional Granger causality panel technique would have been in an effort to learn more about the relationship air pollution and the factors that contribute to it. According to findings from studies that investigated what factors lead to environmental air pollution in countries located in the sub-Saharan region of Africa, "green growth," "renewable energy consumption," and "financial development" all have a positive relationship with one another and are interdependent on one another. There are high hopes that Sub-Saharan Africa's green growth, usage of renewable energy, and financial development would all contribute to a reduction in the region's overall levels of air pollution. These expectations and hopes are reflected in the phrase "high hopes." Therefore, encouraging green development, expanding the use of renewable energy sources, and making it easier for businesses to expand might be important tools for improving the environment in sub-Saharan Africa. To provide just one example: [Introduction] According to the findings shown in Table 5, this conclusion is consistent with the findings obtained from the empirical research carried out by Wang, Chang, Sari, and Cai (2020) as well as Kirikkaleli, Torun, and Sowah (2019). (2021).

Table 5.1 Summary of Dumitrescu- Hurlin Panel Causality Test Results

Hypothesis	W-stat	Z-bar tilde	Result
EAP ↔ GGI	2.931	2.3840 [0.017]*	Bidirectional Causality
EAP ↔ REC	2.817	2.2060 [0.027]*	Bidirectional Causality
EAP → FDI	1.957	0.8670 [0.385]	Unidirectional Causality
EAP → GDP	2.325	1.4410 [0.149]	Unidirectional Causality

Note: ** and * signify 0.01 and 0.05 levels of significance

CHARPTER V

Conclusion and Recommendations

Introduction

It is possible that improvements in environmental quality will be of particular assistance in the effort to promote environmental sustainability. This study investigates the effect that factors such as green growth, financial development, increased energy consumption, and economic expansion have had on the levels of pollution in nations located in sub-Saharan Africa. Following an analysis of the empirical data, this chapter provides a summary of the results of this research article, provides policy judgments, and indicates topics for more research.

Summary of findings

In this contemporary period, one of the most important priorities for environmental policy is to address the challenges posed by environmental air pollution, particularly if one wishes to achieve the goals that are associated with SDG- 7, 12 and 13. Given the importance, this thesis aims was to assess the economic and health sustainability corridor; in particular, linking green growth, renewable energy consumption, and financial development on air pollution in Sub-Saharan Africa. As is the case with the majority of global south, Sub-Saharan Africa continues to encounter a massive air pollution. Therefore, policymakers keenly focused on distinguishing factors that could mitigate Sub-Saharan Africa current rising air pollution scenario. This thesis explores the relationship between the estimated variables using Sub-Saharan African countries panel datasets from 2010 to 2022. The explanatory factors are green growth, renewable energy consumption, and financial development to analyze the impact on air pollution. The thesis employed a new methodological framework and created five models based on sectorial usefulness to accomplish the study objectives. The utilized novel econometric methods of the newly developed Second-generation Panel modelling of Pesaran CIPS and CADF unit-root tests, Mean Group (GM) and Pooled Mean Group (PMG) estimate approaches, as well as Dynamic Fixed Effect (DFE) and the Dumitrescu-

Hurlin causality test, for more precision. In sum, the findings verify that: (i) the Pesaran CIPS and CADF unit-root tests were never stationary at I(0) but when the first difference was applied, all the series were integrated at I(1) and none of the series discovered at I(2); (ii) the estimated variables have both short-long run equilibrium co-integration relationship; (iii) green growth has a negative impact on environmental air pollution in both the short and long runs, with a 1% increase in green growth decreasing environmental air pollution by 0.4340% and 2.466% in the short and long runs; (iv) renewable energy has a negative effect on environmental air pollution, with a 1% increase in renewable energy consumption resulting in a 1.0990% decrease in environmental air pollution; and (v) financial development have a short-term relationship with environmental air pollution. In the short-long run, a 1% change in financial development reduces relation environmental air pollution by 0.2830% and 3.9510%. Infers that, green growth, renewable energy consumption, and financial development have contributed significantly in mitigating air pollution in Sub-Saharan Africa. Other studies by Liu et al. (2023), Kirikkaleli and Adebayo (2020), Mia et al. (2022) and Adebayo (2022) support these outcomes of this thesis.

Policy implication and recommendations

The following policy recommendations are based on empirical findings: The findings show that Sub-Saharan Africa is an energy-dependent region whose economic expansion has been fuelled by adequate energy sources. The total installed power generation capacity in Sub-Saharan Africa is 4339,000 MW, according to the Electric Power Regulatory Authority's (EPRA) 2019 yearly report, with thermal (fossil fuels) accounting for 67% of energy, hydro accounting for 24%, and renewable (wind, solar, and bagasse accounting) accounting for 9%. The feasibility of indigenous resources is questionable in light of the entire energy mix's reliance on fossil fuels and rising air pollution. A sufficient amount of renewable energy is required to sustain economic activity in Sub-Saharan Africa in order for the economy to achieve its maximum level of green living and economic development. To address the issue of renewable energy scarcity and a greener environment, Sub-Saharan African governments should take major steps to ensure the effective use of greet growth, renewable energy resources, and financial development? Investment in renewable energies would promote low-cost energy

access for sectorial operations, which financial institutions and the government may assist with. Given the findings, it is suggested that the institutional frameworks of legal systems be strengthened to accommodate frequent fossil fuel consumption. The main theme of Sub-Saharan Africa should be a stabilizing act of economic and green energy responses. In order to produce better plans and policies for efficient green energy, it is also required to improve the quality of institutions, notably government competency. It is also vital to establish policies that increase institutional quality in the areas of patent rights and eco-innovations.

Given the impact of financial development on air pollution, a number of scientific professionals are thought to be at the forefront of financial sector development that embraces technological innovation. To accomplish professional talent recruitment tactics that match structural growth, authorities in Sub-Saharan African countries should design distinctive, effective human resource policies based on the technological demands of the energy industry. Institutions must be modified to increase technical efficiency. The findings also suggest that governments should promote technical innovation because advances in clean energy are beneficial to efficient and low-cost energy sources. To remove institutional barriers that inhibit energy demand and supply implementation, the government should strengthen its energy strategy and policy direction. These barriers are associated with adequate energy market regulation, renewables installed capacity, R&D investment execution, and public knowledge and awareness of renewables usage. In an energy market with an equal playing field, energy regulatory bodies may seek reforms that enhance RE rather than non-RE generation. Furthermore, institutions should use education to explain the social component of embracing renewables in order to ensure Sub-Saharan Africa's long-term growth

Study limitations and future direction

The economic and health sustainability corridor has only been examined in a few numbers of studies prior to this thesis; it is one of such studies. To be more explicit, the thesis establishes a relationship between environmentally responsible development, the use of renewable energy sources, and the reduction of air pollution in the countries that are located in Sub-Saharan Africa. To account for the

constraints in our findings, future researchers may choose to employ various markers for technological innovation by applying other methodologies, adding different linked variables into studies of energy and air pollution, and focusing on different target groups. Since we only investigated macro-level environmental effects that had an immediate influence on regional variables, researchers may use time series approaches in the future. This is because we only considered such impacts. In addition, studies might be conducted in both developed and developing countries in order to validate the findings over an extended period of time.

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Appendices

NEAR EAST UNIVERSITY

SCIENTIFIC RESEARCH ETHICS COMMITTEE

29.12.2022

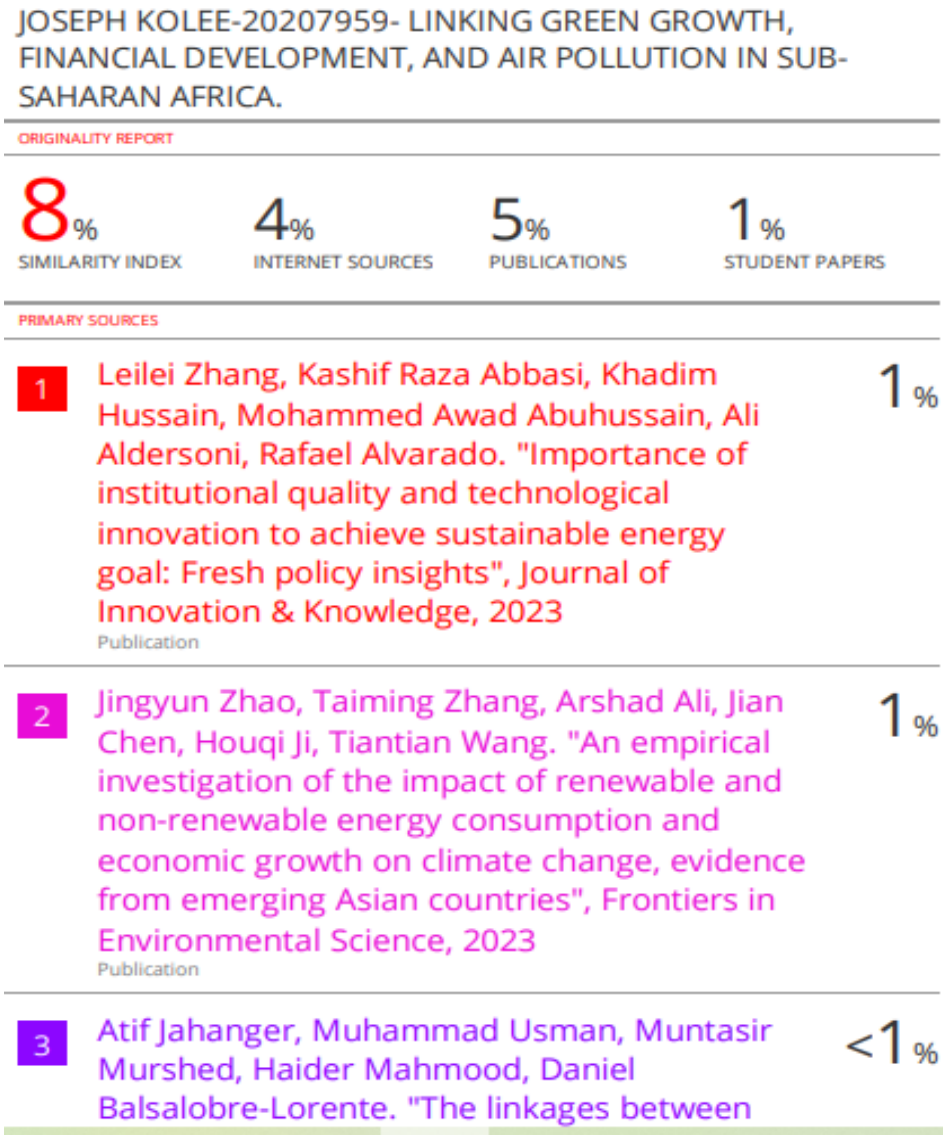
Dear Joseph Kolee

Your project **"Linking Green Growth, Financial Development And Air Pollution In Sub-Saharan Africa."** has been evaluated. Since only secondary data will be used the project does not need to go through the ethics committee. You can start your research on the condition that you will use only secondary data.

Prof. Dr. Aşkın KİRAZ

The Coordinator of the Scientific Research Ethics Committee

Appendix 7: Turnitin Similarity Report



JOSEPH KOLEE-20207959- LINKING GREEN GROWTH, FINANCIAL DEVELOPMENT, AND AIR POLLUTION IN SUB-SAHARAN AFRICA.

ORIGINALITY REPORT

8%	4%	5%	1%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Leilei Zhang, Kashif Raza Abbasi, Khadim Hussain, Mohammed Awad Abuhussain, Ali Aldersoni, Rafael Alvarado. "Importance of institutional quality and technological innovation to achieve sustainable energy goal: Fresh policy insights", Journal of Innovation & Knowledge, 2023 Publication	1%
2	Jingyun Zhao, Taiming Zhang, Arshad Ali, Jian Chen, Houqi Ji, Tiantian Wang. "An empirical investigation of the impact of renewable and non-renewable energy consumption and economic growth on climate change, evidence from emerging Asian countries", Frontiers in Environmental Science, 2023 Publication	1%
3	Atif Jahanger, Muhammad Usman, Muntasir Murshed, Haider Mahmood, Daniel Balsalobre-Lorente. "The linkages between	<1%